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THE

ASA GRAY BULLETIN.

EDITORS:

THOMAS A. WILLIAMS AND CORNELIUS L. SHEAR.

ASSISTED BY

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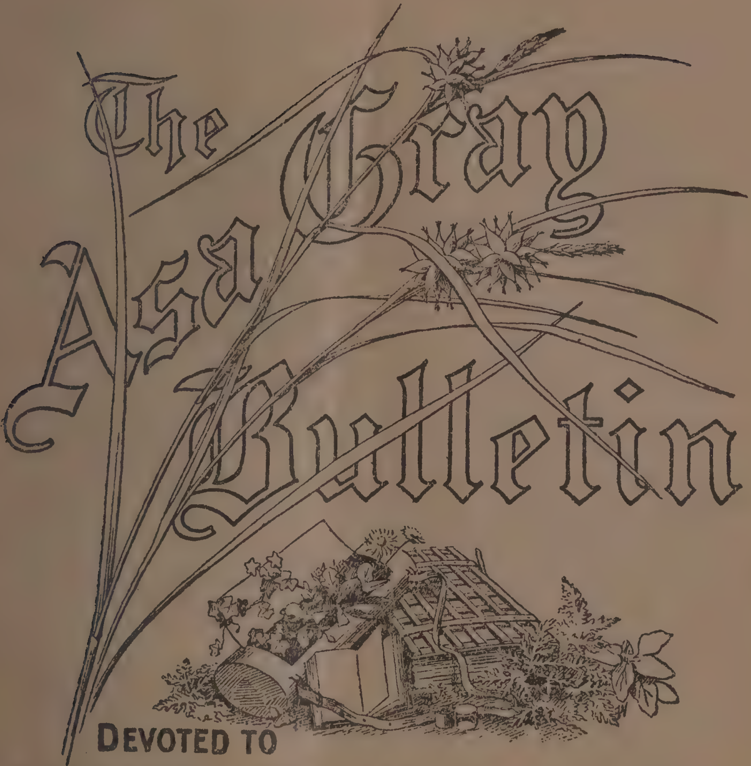

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Half Hours With Lichens—I.

THOMAS A. WILLIAMS.

In this series of papers we shall try to present a few suggestions as to the method of studying lichens in the field and in the laboratory or study, and also to give the more important facts, according to our present knowledge, concerning their structure, development and systematic arrangement.

In order that these articles may be made of the greatest possible practical value to students the writer will be glad to hear from our readers regarding points about which information is desired. In other words, tell us what you want and we will do the best we can to give it to you.

COLLECTING AND PRESERVING LICHENS.

One of the satisfactory things in working with the lichens is that one can collect good material at any season of the year. Another is that these plants can usually be preserved so well in the dried state for all ordinary purposes of study that it is not necessary to resort to the use of such preservation substances as alcohol, formalin, etc., as is the case with fleshy fungi and most algae.

The lichen collector's outfit should be a combination of that of the ordinary botanist and of the geologist. A tin vasculum, a basket, a hand satchel, or the capacious pockets of a hunting coat may be used for carrying the specimens. One should always take along a plentiful supply of wrapping paper, "folders," or paper bags, so that the individual specimen may be kept separate and protected from rubbing or breaking in carriage. It is a good plan to provide a few "pill boxes" in which to carry the more delicate sorts, such as the *Caliciums* and some *Cladonias.*

For removing the fruticulose (Fig. 1A) and foliaceous (Fig 1B) lichens from the substrate, one may carry a small trowel or knife with a long, rather broad blade. The minute forms found on bark and wood must be collected along with a portion of the substrate, and for this purpose a strong, well-tempered, sharp knife is needed. Closely adhering foliaceous, squamulose and crustaceous lichens growing on rocks (Fig. 2) can be best collected with a hammer and chisel. The ordinary geologist's hammer and a common half-inch cold-chisel serve the purpose very well. Many collectors prefer a combined hammer and hatchet, as the latter is often valuable in getting specimens on very firm, hard bark such as that of oak and hickory, or on dry, hard wood. Very dry or brittle specimens should be moistened before one attempts to remove them from the substrate, and for this purpose a sponge kept supplied with water may be used.

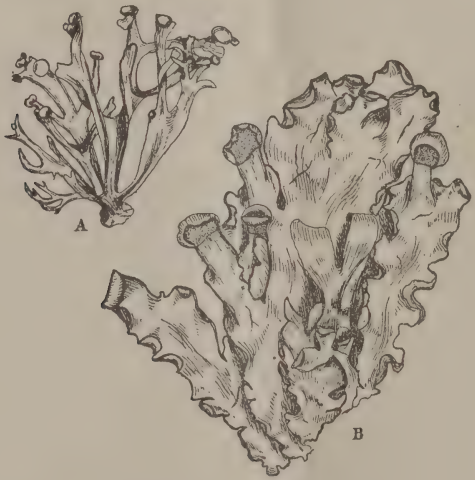

Fig. 1. A. RAMALINA CALICARIS, A FRUTICULOSE LICHEN. B. PELTIGERA RUFESCENS, A FOLIACEOUS LICHEN.

Care should be taken to secure well-fruited specimens, if possible. A good hand lens will be useful in selecting such specimens, also to distinguish between the various more minute kinds, such as the *Biatoras, Lecideas* and *Arthonias*. In the case of

Cladonias (Fig 3) both the *primary* thallus and the fruit-bearing *podetia* should be collected.

In every instance the specimen should be accompanied with full notes as to locality, station, habitat (substrate), etc. It is even desirable to note the particular kind of rock, tree, soil or other substance upon which the specimen was found growing.

It is not usually a difficult matter to prepare lichens for the herbarium. The first step is to see that all brittle or easily broken material is rendered soft and flexible by moistening. This can be done by wrapping the specimens in wet cloth or paper and allowing them to remain for a time. Only cold water should be used for moistening up lichen material. As soon as the plants have attained the necessary softness and flexibility they may be placed between ordinary felt driers and subjected to pressure until dry. The amount of pressure necessary will vary somewhat, according to the kind of lichen, but in any case will be light compared with that given to flowering plants. Wood and bark specimens should have all unnecessary portions of the substrate cut off and, if necessary, should be placed in the press. Green bark should always be kept in the press until thoroughly dry, else it will roll and curl up, which makes it an unpleasant thing to keep in the herbarium. Rock specimens are often diffi-

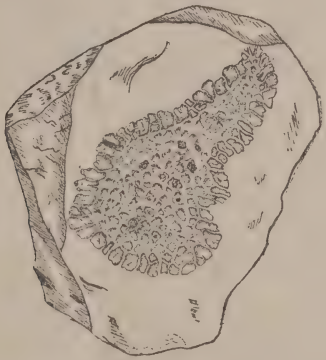

Fig. 2. LECANORA SP., SHOWING A PORTION OF THE ROCK UPON WHICH TH PLANT IS GROWING.

cult to prepare for the herbarium. No more of the rock should be retained than is absolutely necessary to preserve the lichens properly. Sometimes, however, it is next to impossible to reduce the specimen sufficiently so that it can be mounted in the ordinary way. In such cases it may be preserved in a box or tray and a note referring to it may be put in the proper place in the genus cover.

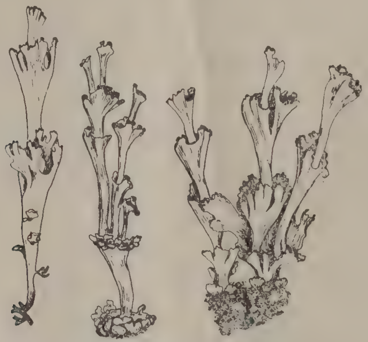

Fig. 3. CLADONIA VERTICILLATA, SHOWING THE PRIMARY THALLUS BELOW AND THE PROLIFEROUS PODETIA ABOVE.

The method of mounting and preserving the specimens in the herbarium will necessarily vary considerably according to the taste of the individual and the means at command. The writer uses the "half-size" mounting paper and puts all but the larger and tougher specimens in the folders or envelopes used by mycologists. Easily broken specimens are fastened to stiff cards of the requisite size by means of glue or thread, and the whole placed in the envelope, which is pinned or glued to the sheet of herbarium paper. Specimens of *Calicium*, *Coniocybe*, etc., are glued to the bottom of small paper boxes or are otherwise protected by gluing narrow strips of pine wood or thick cardboard to the card by the side of the specimen. In the former case the box is glued to the herbarium sheet, and in the latter the specimen is mounted in an envelope in the usual manner.

It is often advisable to mount several specimens of the same species on a sheet. It economizes space and facilitates the work of comparison, and as the herbarium becomes larger, specimens can be arranged geographically. The name of the plant, together with any notes, can be written directly on the envelope or upon a label and this stuck to the envelope, just as one prefers.

Mosses—Their Collection and Study—I.

JOHN M. HOLZINGER.

If you set out to collect mosses with a view to begin their study by using the material you may find, then it is very desirable, and indeed, necessary, in case of most species, that you collect them in good fruit. This must be neither too ripe nor too green. But, to ascertain the proper stage of development is not always possible by simple field examination. It follows that the beginner, to collect successfully, needs to work on and examine microscopically the fruiting material he may have collected. He must, as it were, educate himself for good field work by training his eye to recognize what is material worth taking, and what had best be passed by, at first at least. This he cannot do without reflecting into the field work his discoveries with the microscope as to maturity or unripeness of material collected. Except in rare cases, persons merely collecting mosses gather in too much trashy stuff and pass by most of the more choice smaller mosses. Only a moss student may be reasonably exoected to successfully collect what is really worth collecting in a given locality.

At first the beginner sees only the larger species. It was several years before I succeeded in finding such small things as *Ephemerum*, *Phascum*, *Bruchia* and *Fabronia*, genera not so rare, I am persuaded, as the scant representations in collections indicate. If beginners will but train themselves patiently to look for the smaller species they will surely succeed in the course of a few years in adding materially to the sum total of our knowledge of the smaller mosses and their geographical distribution. The larger species, usually found at first attempt, by even beginners, are less obscurely known, still they are the best material on which to begin work. And in all probability everything, large and small, will draw attention and elicit study.

Lest my suggestion to first collect fruiting material in prime condition be taken in too radical a sense I hasten to say that certain groups of species, like the *Dicrana, Mniums, Polytrichums* and others are identifiable by the leaves alone. And while, in most cases, the technical diagnosis is made by the use of the characters of fruiting specimens, the differences in the vegetative organs alone are usually sufficient to show generic and even specific relationship. It is, therefore, the part of wisdom for a field student to collect everything, laying aside all immature sterile material carefully labeled, till the time when longer experience shall enable him to determine whether it can be satisfactorily studied.

Again, certain species, which require the fruit for satisfactory determination, lose the outer part of the fruit, the calyptra, before the most desirable part, the so-called peristome, is ripe for study. Or, the lid or operculum, flies off so easily that it is very difficult to get complete material in one collecting. And if the student desires to examine all, as he ought to, he frequently needs to collect the same species repeatedly. This, indeed, will be found to be quite unavoidable in any case, since one sees at first only few differences in the gross aspect of mosses. The number of "kinds" or species is at first supposed to be very limited, say five to ten at the outside. But shortly, with study and collecting the horizon widens with pleasurable speed. We learn to see differences, first with the help of scalpel and microscope, and gradually with the unaided eye. And till such proficiency is reached much, very much, duplicate material and trash is necessarily collected. I have myself several bundles, including of course also things that I have not been able to determine and have not submitted to my superiors. To all such things I deem it wise to patiently give storage room "till their appointed time" shall come, whether that be the waste basket or some interesting discovery.

Preparations for a collecting trip for mosses include the tearing up of newspapers to sizes convenient for wrapping up small sods and cushions, for it is very desirable to keep each sod separate in the collecting can or sack. In case of species growing on the ground, or in extensive mats, it pays to take as much pains as time will allow and remove in the field all superfluous soil or other debris. Very delicate species are best collected directly into small pockets of newspaper, folded before the trip similar to those in which moss students send their material through the mails.

The care of the collection at home is of some importance. If species in good fruiting state have been found they should be kept separate in large newspaper pockets, folded properly all around to prevent loss of parts. This precaution is, of course, unnecessary in case of sterile material. The plants, whether in folded sheets or not, should not be laid too densely between several thicknesses of newspaper, or regular botanical pressing paper if the collector can afford it. I have found newspaper perfectly satisfactory. Light pressure only is needed for a bunch of newspapers which contain mosses to dry, less than in case of flowering plants. To expedite the drying, I always, after 24 hours, remove the pressure and spread out on the floor the single folded sheets containing the drying mosses, leaving them thus exposed to dry one or two days, according to circumstances. Then they are returned to pressure and left for another day or two. If, on examination, an appreciable amount of moisture has been again drawn into the paper, I spread them out another 24 hours, which usually dries them sufficiently to require no further attention except to keep them under light pressure such as is furnished by a string tied around the bundle. Care must be taken to add a label to each sheet, giving at least date and locality and habitat.

Before closing this note on collecting I desire to call attention to the curious preferences of certain species of moss for supports on which a student of flowering plants would not expect to find them. There is no difficulty in appreciating the occurrence of mosses on soil. Here belong, of course, the majority, as most *Hypna*, *Polytrichums*, *Bryums*, *Mniums*, *Funaria*, *Physcomitriums*, *Ceratodon*, etc. Nor is the occurrence in water likely to be considered extraordinary; here we find *Fontinalis*, *Dichelyma*, and species of certain groups of *Hypna*. More interesting is the occurrence of mosses on perpendicular ledges of limestone and sandstone, especially when kept moist and dripping, a condition conducive to the growth of *Gymnostomums*, *Desmatodons* and *Didymodons*. Forest trees, especially in moist situations, bear small cushions of species of *Orthotrichum* and *Ulota*, or larger cushions and mats of *Thelia*, *Anomodon* and *Leskea*, these preferably near the base of trees periodically inundated. Lastly, certain species grow almost exclusively on exposed lime or sandstone boulders where no other green plants would grow, and where the young collector least expects to find anything of interest. Yet here luxuriate most *Grimmias* (I know of not a single species of *Grimmia* that grows in other situations) several *Orthotrichums*, the *Coscinodons*, *Andreaeas* and *Hedwigia*. Thus the habitat becomes a most important point to note on a moss label, since a knowledge of the nature of the support of a species will materially facilitate, and may make certain, its determination.

In future papers, it is my purpose to take up, first the larger and more common, and later the smaller and more difficult species of mosses, studying each as a type of a group. And if any of the readers of the bulletin are led to study mosses, and are confronted with difficulties, I shall be pleased to render such aid, by looking over material and correspondence, as my time and limited proficiency enable me to give to my fellow-students. Years ago we had a corresponding section in mosses, in the Agassiz Chapter, of which I was a member. If these lines perchance reach the eyes of former correspondents, I cordially invite a renewal of our bryological friendship.

An interesting series of "Studies in the Cyperaceae," by Mr. Theo. Holm, is appearing in the American Journal of Science. The third article (July, 1897) discusses the germination and morphology of the American *Fuirenas*.

Student's Department.

Conducted by Mrs. LUCY A. OSBAND, Ypsilanti, Mich.

What is a Flower?

FRANK Y. MOSELEY.

Not a great many years ago it was universally believed that the flower was something entirely different from anything else in the whole vegetable kingdom. On this assumption was based the classification of all plants into "flowering" and "flowerless" (Phanerogamia and Cryptogamia), and a hard-and-fast line was thought to exist between these groups. Only in comparatively recent years, with the development of vegetable embryology, has the essential nature of the flower become known and understood, and consequently the term "Flowering-plant" is rapidly disappearing from technical works, and in its stead appears the term "Spermaphyte" or "seed-plant." Instead of the superficially-based classification into Phanerogamia and Cryptogamia we now have the group Spermaphyta co-ordinate with each of the other groups Pteridophyta, Bryophyta and Thallophyta. This arrangement expresses the fact that there is nothing so very peculiar and different in the flower as to justify making the division "Flowering-plants" co-ordinate with all the rest of the vegetable kingdom.

In order to tell what a flower really is in its essential parts it is necessary to begin away back with the Bryophyta, the Liverworts and mosses. These plants, together with all those above them in the scale, are characterized by a peculiarity in the life-history which is ordinarily overlooked and unthought of by the casual observer. This peculiarity is that the reproductive-cell does not grow into the kind of plant that produced it, but into a quite different plant, which when mature produces in its turn reproductive-cells, which, under favorable conditions, develop into the *first* kind of plant. That is, in the complete life-history of these plants, there is an *alternation of generations*, a generation of one kind of plant is followed by a generation of another kind, this by the first kind, and so on.

One of these generations produces the reproductive cells that we call *gametes* (ova and spermatozoa) which must come together in order that their nuclei may fuse, before any further development is possible. Therefore, the plant that produces these cells is called the *gametophyte* (from the Greek *gamos*, marriage and *phytos* plant), and the generation of which it is a member is called the sexual generation. The fertilized ovum or egg-cell develops into a plant of the other generation, which is very different from the preceding one, and which, when mature, produces reproductive-cells which possess the power of developing directly and independently without any fusion or fertilization. These non-sexual reproductive-cells are called spores, and the plant that produces them is called a *sporophyte*, and the generation to which it belongs is called the asexual generation. The spore develops into a gametophyte, and thus the cycle is completed.

In the Liverworts, that which is ordinarily called "the plant" or "the liverwort" is the gametophyte or sexual generation. This bears the sexual organs (archegonia and antheridia) in which are produced the ova or egg-cells and the spermatozoon. The sporophyte, developing from the fertilized egg-cell never becomes independent of the gametophyte, not only remaining in connection with it but being actually parasitic upon the gametophyte. Hence the sporophyte in this group does not attain a high degree of differentiation, having no need for food-getting organs (roots and leaves), since the food is received from the gametophyte already prepared for assimilation. So, in the liverworts, the sporophyte is simply a spore-producing capsule, sometimes borne on a short stalk, sometimes entirely hidden within the tissues of the gametophyte.

In the masses the sporophyte (commonly called the capsule and stalk) is almost as conspicuous as the gametophyte. It remains in connection with the gametophyte (the leaf-bearing part of the so-called "fruiting moss-plant"), however, and is dependent upon it for water and the inorganic salts which it holds in solution. But the moss-sporophyte has chlorophyll and stomata of its own, hence can assimilate carbon-dioxide, and transpire for itself.

In ferns the alternation of generations is very evident, for the sporophyte and gametophyte are separate and independent. But here the *asexual* is the conspicuous generation, and the *sporophyte* is called "the plant" or "the fern," quite contrary, in this respect, to the conditions in the liverworts and mosses. The fern-gametophyte is the little heart-shaped flat green plant called the prothallium. In these prothalli, archegonia and antheridia (sexual organs) are developed, and the fertilized egg-cell of the archegonium develops into the sporophyte or so-called "fern." Almost everyone has seen the so-called, by some systematists, "fruit-dots" (a very bad name) on the under-side of fern-leaves. These are properly called "*sori*," and are groups of sporangia, in which numerous spores are formed by a process entirely asexual or vegetative.

(Concluded in next number.)

A handy "Reference List of Publications relating to Edible and Poisonous Mushrooms," by Josephine A. Clark, assistant librarian of the U. S. Dept. of Agriculture, has just appeared. A copy may be obtained upon request.

"The Fungous Foes of the Farmer," by Prof. Byron D. Halsted, has just been issued in pamphlet form as bulletin 28, of the Pennsylvania Department of Agriculture. It discusses in a popular way some of the more common parasitic diseases of plants; it is attractively illustrated and would be found useful to teachers of botany.

"Farmers' Bulletin, No. 68," of the U. S. Dept. of Agriculture, on the "Black Rot of Cabbage," by Dr. Erwin F. Smith, is an able treatise concerning a very destructive bacterial disease of various species of *Brassica*, which is causing great havoc in various parts of this country.

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To Our Readers..

With this issue the sixth volume of the Asa Gray Bulletin begins. The number of renewals and new subscriptions received since the publication of the December number indicates that there is a growing demand for such a botanical magazine as the Bulletin aims to be. Attention is called to the fact that only original matter, with original illustrations is accepted for publication, and that we would like articles on morphology, ecology (relation of plants to environment) and physiology rather than descriptions of local floras, bristling with Latin names.

Experiment and observation are the keynotes to real plant study. It is not necessary to live in the country or to go into the woods for this purpose. Sow seeds of any kind in a flower pot, cigar box or tomato can; put them in your schoolroom, study or office window—better in your yard—and watch the germination and development. Experiment with different amounts of light, heat and moisture and with various plant foods; be upon the alert for variations, tracing, if possible, their cause; make sketches from time to time and you will soon have material which the Bulletin will be glad to publish. Such matter will be of general interest, while articles concerning local floras or plants collected in a summer's outing are interesting principally to their writers.

We do not wish, however, to restrict our articles to the gross and external features of plants. Papers on structure and development, if not too technical, will be very acceptable. It should be understood, moreover, that we do not decry the value of systematic botany, but there are other journals devoted to this by no means neglected phase of the subject.

Teachers to whom the Bulletin goes are urged to send us frequent notes on the methods and matter found of value in school work; recount also the difficulties you meet in teaching botany. Probably some of our readers have solved these very problems and will be ready to publish their experiences. We wish to make the Bulletin a valuable medium of information to both teachers and students alike.

Please note the liberal offer to schools on the front inside cover. Surely every student interested in plants can afford to pay twenty-five or thirty cents a year for an original, illustrated and wideawake botanical magazine. Observe that this offer holds good only for lists of students sent in by their instructor, and it is only in anticipation of a large number of subscriptions that such unprecedentedly low terms are given. Teachers securing a club of ten names will receive a year's subscription free. Get up such a club among your students and you will be surprised at their increased interest in botany.

News and Notes.

Edw. W. Berry calls attention to the wrong use of the term "analyze" as applied to plants. This word should be left to the chemists, while botanists should use the term "identify" or "determine" in connection with plants.

Rev. A. C. Waghorne, Bay of Islands, New Foundland, has a collection of hepaticae of that region and from Southern Labrador, some of which he is unable to determine, with means at his command, and he desires aid from some one interested in this group of plants.

With the last issue for December, 1897, the Garden and Forest ceased to exist. We regret exceedingly that a journal of such a high standard of usefulness did not receive adequate support. American students of science as a class have not yet learned to appreciate the value of scientific publications, and it seems that few journals of this character are yet self-supporting.

Few lines of botanical study are more interesting to the young student and few more likely to be productive of real practical value than the study of trees, laying a foundation for a knowledge of forestry. For this study the Lewis Leaf Charts, with their accurate delineations of leaves and fruits, will be found most acceptable aids by both teachers and students.

Mycological Clubs.

The first mushroom club of the United States was organized on March 6, 1895, in the village of Westfield, Chautauqua Co., in Western New York, under the name of "Toadstool Club" with thirteen members. Miss Lydia M. Patchen is president and one of the other officers is called physician and taster.

The second, and possibly the most flourishing, is the Boston Mycological Club, which came into existence in August, 1895, and now boasts of four hundred members. Mr. Julius A. Palmer, was the first president. This club has issued a number of bulletins and reports.

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Next on the list comes the Philadelphia Mycological Center, of whom Capt. Charles McIlvaine, the best known mycophagist in America, is president, and the far-famed Mrs. Sarah Tyson Rorer, vice-president. It consists of about fifty members.

In April, 1897, the New York City Mycological Club was organized with Prof. L. M. Underwood, of Columbia University, as president, and counts at present nearly a hundred members.

The Washington City Mycological club met for the first time on Nov. 1st, 1897, in the Columbian University, electing Mr. T. A. Williams, of the Agricultural Department, as president. It has already enrolled about twenty-five members.

MRS. MARY FULLER.

Noxious Boleti.

Philadelphia, Jan. 10, 1898.

To the Editor:

I notice in the October (1897) number of the Asa Gray Bulletin, on page 75, Mrs. Williams' article on edible boleti, in which she speaks of noxious species. I would very much like such described if possible, as I have for about twenty-five years been a fungus eater; adding each year to my edible varieties of the year before, and I have eaten freely of all of the boleti with the exception of *Boletus felleus*, which is too bitter to be pleasant, but as I have repeatedly taken it raw it can not be noxious.

Last year for two months, my family guests and self had once a day a good mess of boleti; so I should say that with the above exception, *all the boleti are edible.* In our summer school at Mt. Gretna, Pa., where we always have an abundance of boleti, I have repeatedly told those in our colony "*that all boleti were edible,*" so that they have without hesitation cooked and ate freely without any bad effects.

SARAH TYSON RORER.

While thus encouraged to rejoice that "all things are lawful" there still linger grave doubts as to the expediency of eating "all Boleti." There is little doubt that many of the suspected species are edible; still many people—some with excellent reasons for their conservatism—reject a number of species. The writer has not had 25 years experience eating fungi but is willing to try it for that length of time, if permitted to do so; and in order not to be classed with those who no longer wish to live, could not be induced to partake of at least half a dozen of the species to be found in this locality. *Boletus piperatus*, quite common here, has no known friends and, though harmless in appearance, can hardly be wholesome. Another species, not so common and, so far, unknown, is a large fungus sometimes weighing several pounds. It has a pleasant odor, and looks altogether desirable, but shut in a room with it the odor becomes more and more penetrating, finally producing a feeling of nausea. Of the taste "deponent sayeth not," the smell being sufficient, but it is a fine looking fungus and might easily be cooked and eaten before the odor became offensive. The effect on the digestive organs would not be hard to imagine though it may be edible. Space forbids the mention of others if it were desirable to do so. Our plan for the study of fungi makes no provisions for the eating of anything that the eater does not know.

We earnestly protest against the statement that all of this or that genus are edible, particularly of such large and little known genera. Some people can eat many species that the majority must pass by. One writer maintains that *Russula emetica* is "all right if properly cooked." Raw, it tastes like mustard, only stronger. A mustard plaster may be all right if properly cooked, but most people prefer something else.

A colored woman of Washington enjoys a dinner of *Amanita muscaria* when properly prepared and cooked, but finds few to follow her example—who live to tell of it.

MRS. MABEL E. WILLIAMS.

Observations.

Cactus Vitality.

A short time ago, in looking over some old, unmounted plants, I came upon a specimen of cactus, which I had placed in a thread box because the spines would not accommodate themselves to any other situation. The stem had sent forth shoots resembling potato sprouts. Although the cactus fragment had been in the box undisturbed for two years and a quarter the shoots were fresh and firm, some of them being over six inches long, though much curled up to conform themselves to the restricted space.

MARY E. CARR.

Petals and the Visits of Bees.

Are petals as important as color-signals in attracting the attention of insects flying near by, as was supposed by Sprengel and most subsequent investigators of the relations of flowers and insects? Occasionally the assertion is made that when the petals are removed insects still continue their visits. The last repetition of this statement has been brought to my attention within a few months. Clearly the only course is by experiment to appeal directly to Nature to answer the question.

To determine the influence of the petals of the common pear, *Pyrus communis L.*, upon the visits of the honey-bee, *Apis mellifica*, a medium-sized tree in full bloom was selected for observation. The day was clear, warm and calm, the bees were numerous and no other insects were present.

1. A cluster of seven blossoms near the end of a branch was watched for fifteen minutes and received eight visits of the honey-bee. The petals were now all removed and it was observed for a second quarter of an hour. Though a number of bees flew near by it received not a single visit. During a third fifteen minutes there were two visits, due partly to accident, partly to association, for the bees came from other blossoms on the same tree, which had proved the first source of attraction.

2. Two other clusters of flowers, growing side by side but nearer the bole of the tree, consisting each of eight flowers, were observed for fifteen minutes and sixteen separate visits of the honey-bee were noted. The petals of one of these clusters were now removed. During fifteen minutes the adjacent cluster, which still retained its petals, received eleven visits while not one was made to the cluster without petals. In one instance a bee hovered over it but did not alight.

These experiments were much more conclusive than I had expected, and proved beyond all doubt the value of petals to wheel-shaped flowers in securing the attention of the honey-bee.

John H. Lovell.

A Double Trillium.

Among the many beautiful wild flowers which deserve and endure transplanting to the "wild-flower bed" of the lawn, *Trillium grandiflorum* is one of the finest. It will grow and bloom in great beauty where not a ray of direct sunlight ever finds its way. The most limited lawn should furnish space for a few Trilliums. Even only a foot square thus planted will repay any lover of wild flowers, and would serve to engender an interest where it did not already exist. Besides the pleasure and interest one has in the normal growth of the plant, interesting and novel variations now and then come to light, either in connection with the leaves or the flower.

The accompanying illustrations of a double *Trillium grandiflorum* must certainly be a rare form. Ten years ago Mrs. Walker found growing in the woods of Jefferson county, Ohio, a double *Trillium grandiflorum*; she transplanted it to her garden, where it has grown and each season has bloomed, always producing the double flower.

In the spring of 1896 Mrs. Walker presented a portion of the root to the Botanical Department of the Ohio State University. This was planted in a flower-pot and kept in the greenhouse, where it grew thriftily and produced three double flowers, as shown in the illustration. The flower, still in bud, when the drawing was made, afterwards bloomed; and the three flowers made a beautiful sight and were greatly admired by all who were so fortunate as to see them in their prime.

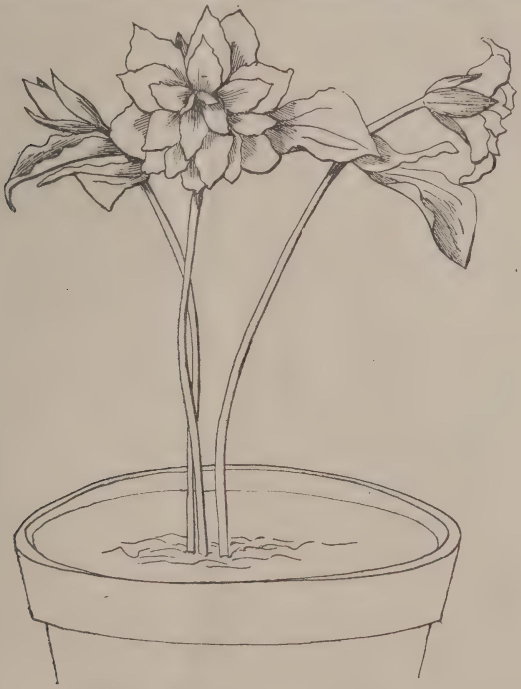

Fig. 4. A DOUBLE TRILLIUM.

When the flowers began to wither they were cut and given to me for preservation. One was pressed intact, the others I carefully dissected, and mounted the different whorls as indicated in Fig. 2. One of the Trilliums thus mounted shows nine, the other thirteen whorls of petals. The whorls alternated quite symmetrically, as shown in the figure. The stamens and pistil were aborted to mere vestiges—consequently no seed would have been produced. The plant and flowers attained the average normal size, and aside from the peculiarities noted, was normal throughout. The flower was pure white, assuming no tinge of pink even in withering.

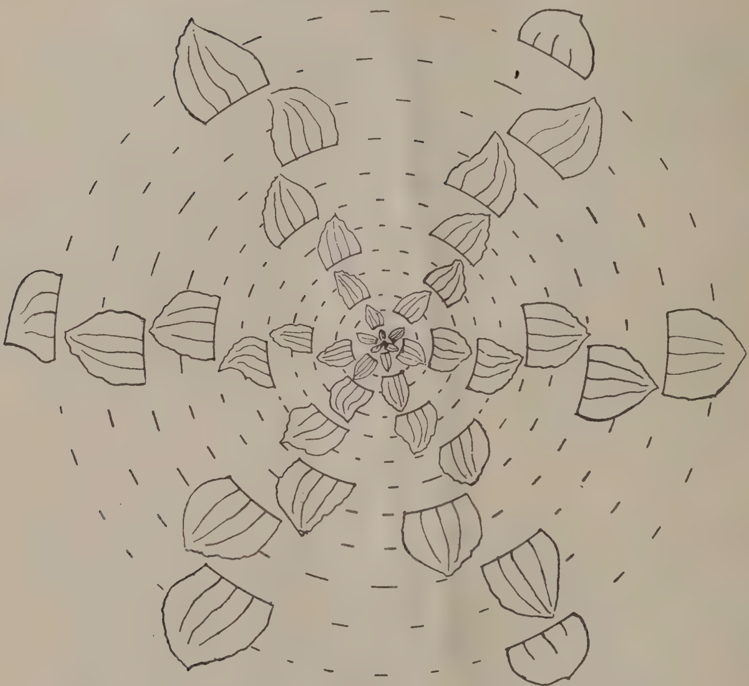

Fig. 5. ARRANGEMENT OF PETALS IN DOUBLE TRILLIUM.

Prof. Charles A. Davis, in his paper, "Trillium grandiflorum; its variations normal and teratological," presented before Section G. of the A. A. A. S., speaks of examining several hundred abnormal specimens; he found the simplest departure from the normal to be the occurrence of green stripes in the petals; but in all the variations mentioned by him there is nothing approaching this double form. The fact that this double Trillium has been existent for ten years—and we know not how long before it was transplanted—renders it especially interesting. The one thing that is to be regretted is that the mehod of propagation, by division, must necessarily be too slow to furnish specimens to the many who would rejoice in the possession of a plant so novel and beautiful.

MRS. W. A. KELLERMAN.

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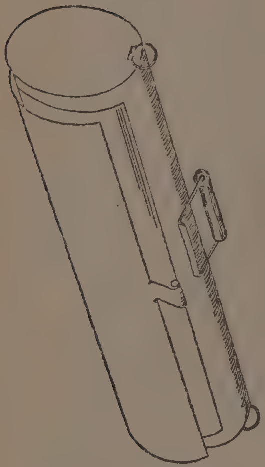

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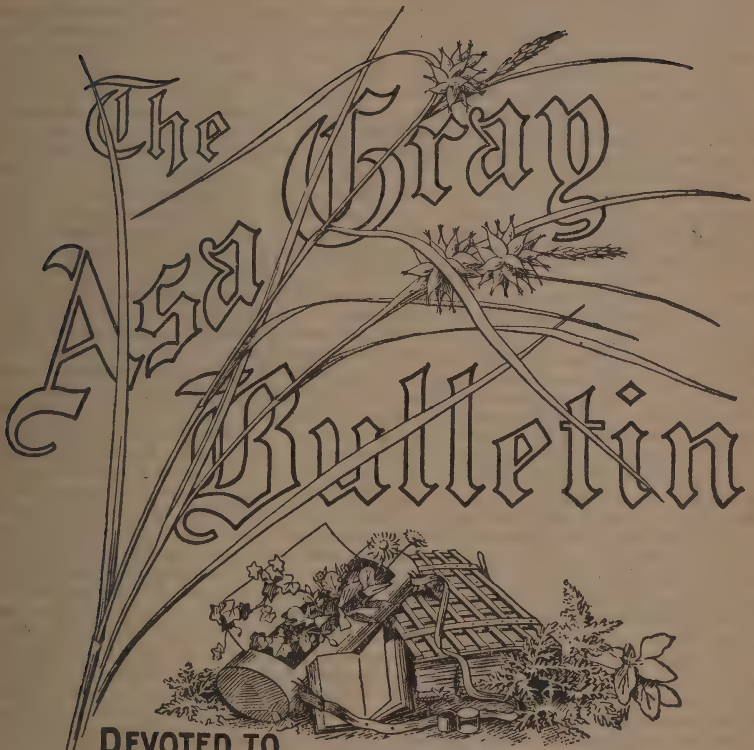

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Asa Gray Bulletin.

Vol. VI. No. 2. APRIL 16, 1898. Whole No. 25.

"Sporting" in Peaches.

Byron D. Halsted.

A large grower of peaches recently brought to the Experiment Station a "surprising freak," as he called it, from one of his peach trees. So far as the leaves were concerned the branch did not differ from the ordinary peach tree; but the fruit, instead of being covered with the usual thick coating of down or "fuzz," had a smooth skin and was, perhaps, somewhat more flattened than the ordinary peach.

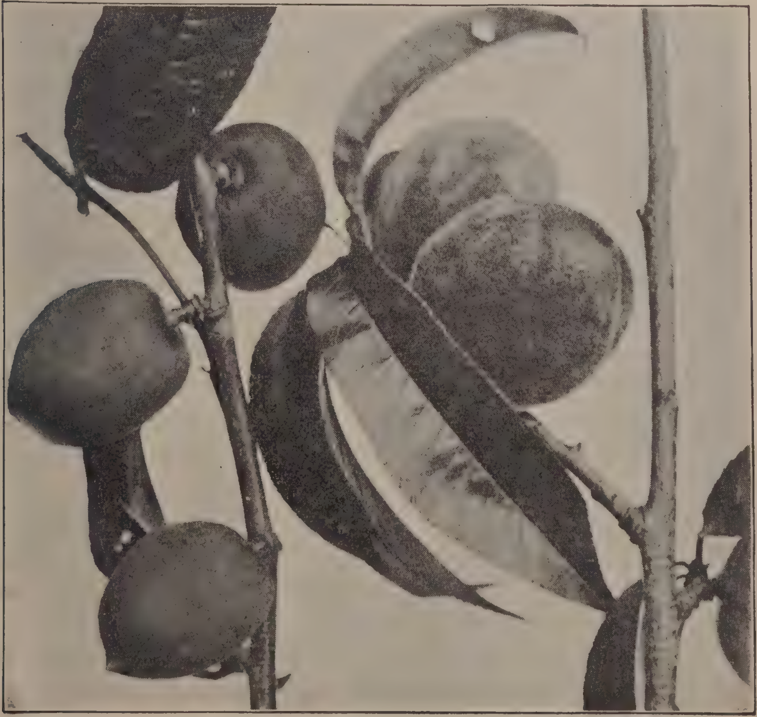


Fig. 6. NECTARINE AND PEACH FROM SAME TREE.

One large branch of the tree is thus changed, and the case seems to be another striking instance of a nectarine being produced from the peach by bud-variation, or, more generally speaking, by a "sport."

The accompanying engraving, Fig. 6, is made from a photograph of a portion of two branches from the same peach tree. Upon the left branch, which is purplish and shows darker in the picture, there are four nectarines, three in full view and the upper one mostly out of sight. The right branch shows that its bark was much lighter-colored than the nectarine twig, and bears two peaches upon a side branch. The two kinds of fruit are brought near together that the relative sizes and difference in character of surface might be shown. While the nectarine is much smaller than the peach it was found that the pits of the two sorts of fruit were of the same size and almost identical, and it follows from this that the flesh of the peach is considerably thicker than that of the smooth-skinned sport.

When the eye is trained to it, many signs of variation will be found in the various parts of a large number of our common plants, although some sorts are more disposed to variation than others. The change is usually higher in the form or the color of the parts, and is often preserved by propagators, thus introducing a new variety often of great worth.

One cannot offer any full and satisfactory reason for this freak in one branch of a single tree in a large orchard of peaches, but it may not be without interest to note what some of the authorities upon fruit growing have written upon this subject.

Hon. J. A. Fulton, in his work entitled "Peach Culture," on page 11, states that the nectarine is a smooth variety (var. laevis) of the peach, and upon page 13 states: "There is abundant evidence that the latter (the nectarine) is a mere accidental production of the former (the peach). The general characteristics are identical, while the difference is slight, and consists principally in the presence or absence of the pubescence on the skin. The nectarine in both tree and fruit is not so vigorous, hardy or durable as the peach; it is more easily affected by disease and the attacks of insects; sheds its fruit more easily and oftener fails to produce."

Mr. P. Barry, in his "Fruit Garden," page 394, states: "The nectarine is derived from the peach; the trees are precisely alike and the fruit differs only in the nectarine being smooth-skinned. It is peculiarly liable to be destroyed by the curculio. The preventive remedy against curculio must be applied as with the plum." Thirteen named varieties are described.

Mr. J. J. Thomas, in his "American Fruit Culturist," page 346, states: "The nectarine being nothing more than the peach with a glossy skin, the same rules for cultivation will apply equally to both. * * * The nectarine is usually inferior, and has more of the Noyau flavor than the peach and shoots are of a smoother and more compact growth." He classifies fourteen varieties with the freestones and clingstones and then into pale flesh and yellow flesh.

George Nicholson, in his "Illustrated Dictionary of Gardening," Vol. II, page 422, states: "The nectarine is a form or variety of the peach distinguished from it in general characters by the fruits having a smooth instead of a rough skin. For example, the same tree has at times produced fruit of both kinds on the same branch; and even a closer relationship has been recorded in a single fruit being half a nectarine and half a peach. Nectarines are, however, sufficiently distinct in flavor and general appearance to be constituted and considered as a separate fruit, both for dessert and exhibition purposes."

Nicholson describes 19 varieties, the size of flower, size, color and shape of fruit, and character of leaf glands being the leading points of distinction. The fruit of the nectarine, as in peaches, may be either cling or free-stone. The color varies from white, orange and yellow to red and dark purple.

Professor Bailey, in his "Plant Breeding," page 118, says: "Nectarines are derived from the peach, some of them as sports and some as seedlings." Again, at page 173, under bud variation, he writes: "The fact of the nectarine coming suddenly from the peach can no longer be doubted."

Upon this subject Dr. Goodale says, in his work upon "Physiological Botany," page 444: "While in most cases buds produce shoots or plants very closely resembling the parent, it sometimes happens that remarkable variations arise. These are known as *bud-variations* and are commonly called "sports." In general, when once originated they are perpetuable by any of the processes of bud-propagation just described, but are not likely to be reproduced by seed. From the long list of them given by Darwin only a few familiar cases are here mentioned: (1) the moss-rose from the Province rose (*Rosa centifolia*); (2) Pelargonium, giving rise to numerous varieties; (3) Dianthus, Sweet William, carnations and pinks, which vary very widely in cuttings from a single plant.

Many of the cases of sports, especially those which have descended from the hybrids, are attributable to reversion to an ancestral form; a few seem to be dependent on changes in the surroundings, while others have been attributed to the influence exerted by a graft. Ordinarily the scion produces no marked effect upon the stock and conversely the stock exerts no effect upon the shoot growing from the scion."

Dr. Asa Gray, in his "Structural Botany," page 319, says: "Some varieties of cultivation originate in comparatively slight deviations from the type, and are led on to greater differences by strict selection of the most marked individuals to breed from. Most appear, as it were, full fledged except as to luxuriance or development, more or less under the control of conditions, their origin being wholly unaccountable. They arise in the seed bed or sometimes from buds, which as the gardeners say "sport." That is, some seedlings or some shoots are unlike the rest in certain particulars. Most varieties originate in the seed and, therefore, the foundation for them whatever it may be is laid in sexual reproduction. But bud-variation or the "sporting" of certain buds into characters, in branch, flower, or fruit, unlike those of the stock is known in a good number of plants. * * * Once originated these varieties mostly persist, like seedling varieties, through all the generations of budding growth, but are not transmitted to the seed."

A list of known variations is given in Chapter XI of Darwin's "Variation of Animals and Plants under Domestication."

Rutger's College, N. J.

Some Pine Barren Carices.

C. F. SAUNDERS.

The sphagnum bogs and sandy plains of the Pine Barrens of southern New Jersey are quite rich in interesting members of the Sedge family, among which are several of the less common species of carex. Of these probably the earliest to attract the collector's attention is *Carex umbellata*, which last year the writer came upon in flower as early as April 3d. It is a dwarf species, and may be occasionally found in the dry sand of fields and along old wood roads, forming dense mats, each a few inches across. The pistillate flower spikes are almost hidden among the leaves, which cluster about the bases of the short culms and much exceed the latter in length. The staminate spikes, borne singly on scapes only an inch or two high, are purplish brown in color, and when in flower are gayly spangled with the yellow anthers, which protrude from all sides on slender filaments. Blooming as early as it does and before other spring flowers have fairly begun to open our little sedge is one of the cheerfullest of April sights in the sandy solitudes where it loves to dwell. New Jersey appears to be its most southern limit.

It is about the swamps, however, and in May, that we shall find carices in most abundance in the Pine Barrens. Of these one of the most beautiful is *C. littoralis*, with very short pale leaves from amid which the straight culm rises one to two feet in height, terminating in a slender spike of staminate flowers. Below this and on the same culm the pistillate spikes, which are usually tipped with a few male flowers, droop gracefully on thread-like stalks. Each green seed vessel is cradled in a purple scale, and the resultant alternate markings of green and purple make the fertile spikes objects of striking beauty.

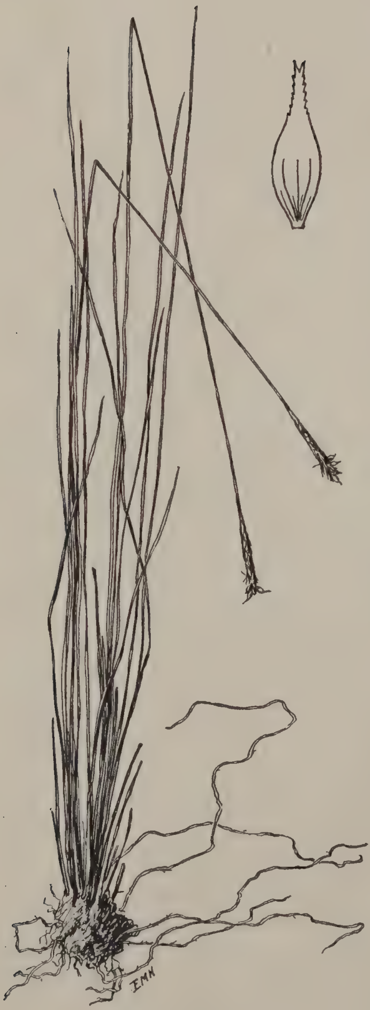


Fig. 7. CAREX EXILIS.

C. exilis (Fig. 7), a denizen of the cold swamps of Labrador and Newfoundland, is equally at home in the bogs of the New Jersey Pine Barrens, where it reaches the southern limit of its range. It is a plant which most will probably esteem more odd than beautiful, with stiff narrow leaves, rolled at the edges, and slender culms terminating above in solitary rusty brown spikes, which sometimes consist almost wholly of staminate flowers, while sometimes the pistillate predominate. It is said to be occasionally quite dioecious. In the same bog with this sedge we may look for another, which is as characteristically southern as *C. exilis* is northern—namely: *C. striata* var. *brevis.* Just as *C. exilis* reaches in New Jersey its furthest south, so in the same locality does this sedge reach its furthest limit north. It is one of the most charming of its tribe, with rather long, club-shaped spikes of seed-vessels and narrow leaves that dispose themselves in graceful lines.

C. sterilis (Fig. 8), is a delicate species growing in dense tufts with fine thread-like leaves, amid which the culms are mingled, strung with small, roundish clusters of seed-vessels. In the plant of the New Jersey bogs, the uppermost portion of the culm, instead of being produced to the tip in a continuous straight line, is often sharply deflected at the base of one of the spikes so that the next higher spike is borne away from it at an angle of from 45 to 90 degrees—a characteristic I have not noticed mentioned in the manuals. So, too, the manuals are silent as to the stoloniferous habit of *C. bullata*, another of the Pine Barren sedges, although specimens collected in New Jersey by Benjamin Heritage show this character so strongly as to make it worthy of note.

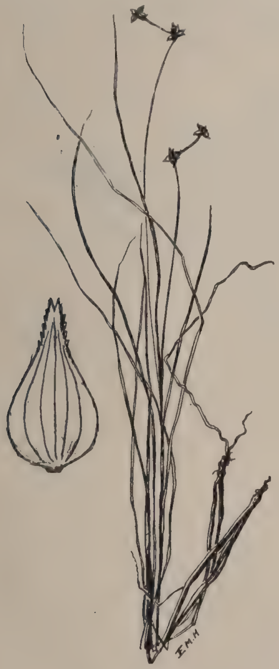


Fig. 8. CAREX STERILIS.

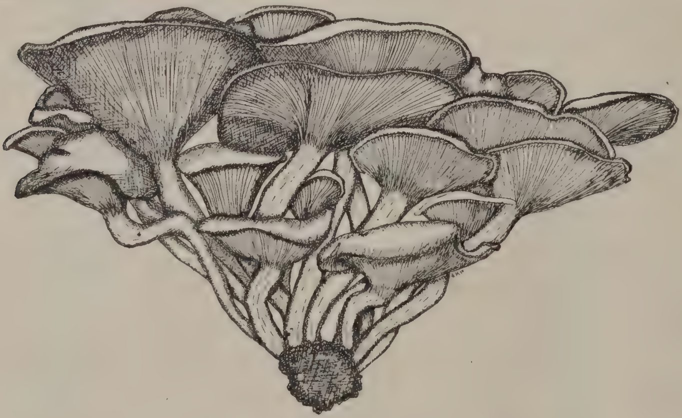
In the cedar swamps, where the perpetual twilight restricts the number of flowering species to very few, *C. subulata* finds a congenial home, luxuriously couched in beds of sphagnum moss. It is a languid-looking plant with delicate culms that often recline, and awl-shaped seed-vessels which droop in loose clusters from short upright stalks. These seed-vessels are well distinguished by having the points of the tapering beaks sharply bent back so as to form tiny hooks—a characteristic which will soon force itself upon the attention of the collector when he takes his specimens from his vasculum, for he will probably find them all clinging tenaciously to one another, the hooks interlocked.

The broad flat leaves of *C. folliculata* in the southern New Jersey bogs remain fresh and green throughout the winter, and form as they lie in broad mats, conspicuous objects in the bare swamps of February, at which early time we may find the new leaves already putting forth in compact, three-angled shoots.

The "Jack My Lantern" Mushroom.

MRS. MABEL E. WILLIAMS.

Going through the woods one day in early autumn last year, I came upon a tangled thicket, which, in spite of the briars at its portals, promised fungus treasures to one who was willing to make a way through its guarded doors. Inside was an open place through which the sun streamed brightly and on the ground below, enjoying a sun bath, was as gorgeous a sight in the fungus line as one is often privileged to see. A clump not less than three feet in diameter and almost as high; a mass of gold and brown with the caps curved, twisted and fluted into innumerable fantastic shapes. The colors ranged from the brightest of golden yellow to a velvety brown—a combination so harmonious it seemed a sin to mar it with a touch. The fittest use one could imagine for it was for the queen of fairies, for such splendor of color and form suggested nothing short of royalty itself.



JACK MY LANTERN.

Later in the season a cluster composed of hundreds of pilei and weighing in all about fifteen pounds appeared in a neighbor's yard. A good-sized bunch was placed on the kitchen range to dry and on entering the room in the dark I was amazed to see bluish outlines of the gill surface of the mushrooms, the phosphorescence being confined to the gills and spores. An elderly darkey-bachelor happening along the next day was asked if he was familiar with it. "Yes, Miss; I done see that many's the time. That's a 'Jack My Lantern.' Please give me one to show the girl." He departed happy, evidently believing himself possessed of a "charm" though wherein its potency lay he did not disclose.

A cleaner and more wholesome looking fungus than *Clitocybe illudens,* for that is its real name, would be hard to find, nor is any fault to be found with the smell or taste, both being all that could be desired. But alas, all is not pure gold that is of that color, in the mushroom world, at least. Its charms have tempted many to taste, and the results in most cases are painfully alike.

One man though he had the "golden chantarelle." He ate it, liked it, and ate no more mushrooms for many days. His illness was very distressing and he thought he was going to die, though it is not likely that his life was really in danger. In another case a family of six persons ate of it. Previous to its being cooked it was washed, contrary to the orders and much to the regret of the head of the household. The water in which it was dipped became a bright yellow and the superintendent of ceremonies lamented that the "goodness" was all being washed away in the water. His lamentations were changed, however, when, an hour or so after dinner, which they all enjoyed greatly, the consomme, like Banquo's ghost, refused to "down." They were all exceedingly but comfortably sick. This condition lasted most of the night but did not render them at the time incapable of perceiving the ludicrous side of the situation or hinder them from eating other mushrooms after a few days had passed. The author of the mischief (the man, not the mushroom,) declared he could have eaten the same fungus the next day with relish, and would prefer it every day for a month to trying again a dish of over-ripe puff-balls (*Calvatia cyathiformis*) that he ate on another occasion. The mild action of the fungus in this instance was probably due to the washing away of a large amount of the vile-looking deposit that is to be found abundantly on the stems, gills and edges of the cap in most plants. There are instances recorded of people eating it without harm, complaint being made, however, of a disagreeable soapy taste. Whether the sickness is caused by a poisonous principle or by indigestion is not known fully. The fungus can hardly be classed as dangerous, but is one that it would be well to feast on "only with thine eyes."

The following are the distinguishing characters of this plant: Pileus at first convex, becoming more or less perfectly expanded, smooth, slightly umbonate, orange yellow; lamellae narrow, unequally decurrent; stipe long, solid, tapering downward. The height varies from 4 to 10 inches and the pileus expands from 2 to 6 inches.

The fungus is most abundant in the autumn, particularly during September, and is usually found growing in soil containing a large amount of decaying wood, as where an old stump has been entirely covered with earth.

An excellent description and plate of this fungus is given by Prof. Chas. H. Peck, in the 49th Annual Report of the Botanist of the State of New York.

In 1896, tonka beans were imported into the United States from Venezuela to the value of over half a million dollars.

According to a writer in the Century a fad for raising morning glories is fast superseding the chrysanthemum craze in Japan. These morning glories are called "asagaos" and appear to be distinct from the ordinary *Ipomoea purpurea* and *Convolvulus major*.

A more simple method of extracting perfume from flowers than by means of oils is said to have been discovered by a Frenchman, and consists in dipping the flowers in water, the water being renewed as fast as it becomes charged with the odor. Afterwards the perfume is extracted from the water by the aid of ether.

Lycopersicum esculentum, Mill. One of the earliest references to the use of the tomato as a food is to be found in a book entitled "Flora Diaetica," written by Charles Bryant in London, in 1783. Under the name "Tomatas," the Portuguese and Spaniards culitvated the fruit at that time, and used it as an ingredient in all their soups and sauces. It was considered both cooling and nutritive. V. K. CHESNUT.

Students' Depatiment.

Conducted by Mrs. Lucy A. Osband, Ypsilanti, Mich.

What is a Flower?

FRANK Y. MOSELEY.

(Concluded from page 11).

In the "water-ferns" and some "club-mosses" (Selaginella) two kinds of spores are produced, differing greatly in size. Hence they are called *micro*-spores and *macro*-spores; the structures in which they develop are called microsporangia and macrosporangia, and the leaves which bear the sporangia are called microsporophylls and macrosporophylls, respectively. In these higher Pteridophytes the prothallia are extremely small and simple, and the sexes are separate, male prothallia being produced from the microspores, and female, from the macrospores. These prothallia are so small that in some cases they are entirely contained within the spore-wall, and consist of only one or two cells besides the antheridium or archegonium.

Now we are ready to study the flower of Spermaphyta (Phanerogamia) and by carefully tracing in it the homologues of the structures above described, to understand it.

The flower is a collection of more or less modified leaves, arranged in several circles or whorls. The calyx and corolla scarcely concern us in the present study, being accessory and non-essential, the calyx for protection of the bud, the corolla for conspicuity. The stamens and pistils are the essential parts, and it is with these alone that we are at present concerned. A stamen does not look like a spore-bearing leaf, but such it is, homologous with the spore-bearing leaf of a fern. More strictly still, the stamen is homologous with the *micro*-sporophyll of the higher Pteridophyta, for pollen-grains, as we call them, are really *microspores*, and the "flowering-plant,"—the oak tree, the rose-bush, the geranium is really only the sporophyte—the asexual generation. The sexual generation, represented by rudimentary prothallia or sexual plants, is so very much reduced, and remains in such close connection with the sporophyte, that it is overlooked altogether by most people.

In the anther there are usually four microsporangia (only two in some orders, and in one order, many). In these are produced the microspores, or pollen-grains.

The pistil is a macrosporophyll, or, if compound, several of these united. In the systematic botany of Angiosperms, the macrosporophyll is called a *carpel.* The ovules, which are borne upon (usually) the carpels, are, morphologically, *macrosporangia,* surrounded by more or less investing tissue, except at one point, the micropyle. Usually only one macrospore (or "embryo-sac") is developed in a macrosporangium. The proptoplasm of the macrospore divides up into a number of cells. This group of cells (only a few in Angiosperms) represents the female or egg-bearing plant of the sexual generation—the female prothallium or female gametophyte. In most Gymnosperms the archegonium (female organ) is well developed, but in Angiosperms it is reduced to a single cell, the egg-cell.

The pollen-grain or microspore germinates on the stigma, where it has fallen or has been deposited, and a filamentous structure ("pollen-tube") is developed, which, as it grows, pierces the style, and growing down through it, finally reaches the micropyle of an ovule. This pollen-tube is the very rudimentary *male-prothallium,* consisting of but two cells. One of these is vegetative, the other is the male sexual cell or spermatozoid. The antheridium, like the archegonium, is reduced to a single cell—the essential one. When the pollen-tube has grown down to the ovule, and, passing through the micropyle, has come into contact with the egg-cell, the male element leaves the pollen-tube and fuses with the egg-cell, thus effecting fertilization. The fertilized egg-cell develops into a sporophyte-embryo, and this, surrounded by the hardened wall of the ovule, constitutes the seed in many cases (exalbuminous seeds), but in most monocotyledons and in some other cases, the female prothallium grows very considerably after its egg-cell has been fertilized, and forms a compact mass of cells rich in stored-up food material. This mass of cells is called the endosperm, and this kind of seed is called albuminous.

Thus it has been shown that the "flower" is not distinctive of any one group of plants, as all its parts are found in several of the principal divisions of the vegetable kingdom, and that the peculiar thing about the so-called "Flowering Plants" is that "the macrospore ("embryo-sac") is not set free from the macrosporangium (ovule) as is the case in the heterosporous Pteridophyta; nor does the macrosporangium itself separate from the plant producing it until it has ripened into the seed; this being so, the macrospore germinates inside the macrosporangium, producing there the female prothallium with its reproductive organs; fertilization of the oosphere (egg-cell), as also the development of the embryo from the oospore (fertilized egg-cell), takes place inside the macrospore; and thus the seed is formed. If the macrospore were set free from the macrosporangium, no seed would be formed; but in that case the condition of things would be that which actually exists in the higher heterosporous Pteridophyta, such as Selaginella." [Vines' Text-Book of Botany, p. 460.]

Any one wishing to look up the subject further, will find it briefly treated, with illustrative figures, in Campbell's little text-book of "Structural Botany," and with more detail, in Vines' text-book, referred to above.

Colorado State Preparatory School.

The marshmallows of confectionery shops are made from the roots of *Althaea officinalis*.

The rubber of the Orinoco region is made from the milky juice of *Hevea braziliensis*, one of the Euphorbiaceae.

Newspaper bulletin No. 21 of the Nevada Experiment Station, discusses the relative character of "Lobelia," "Larkspur," "Loco-weed," and "Wild Sego," as a cause for the poisoning of cattle in Nevada in spring-time. Prof. F. H. Hillman, the author, appeals for further information and accounts of cases, but is inclined to believe that only the latter plant, *Zygadenus venenosus*, is responsible for the poisoning. A comprehensive chemical, botanical and toxicological investigation is to be made.

V. K. CHESNUT.

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Notes.

Apropos of Mr. Berry's distinction between "analyze" and "identify," made in the February Bulletin, Jas. A. Graves claims that since one can neither identify nor determine plants without first analyzing them, the word "analyze" must be retained in the botanist's vocabulary. "Artificial keys are analytical tables to aid in identifying or determining species. The terms 'identify' and 'determine,' though generally used as synonyms are not really so. We can only identify plants which are already known to us, while we determine species which to us are new."

Through the courtesy of Mr. Hollis Webster, Secretary of the Boston Mycological Club, we are able to give extracts from a letter written by Frank S. Collins, of Malden, Mass., on an undoubted case of boletus poisoning. Mr. Collins says: "I ate of what Dr. Peck pronounced *Boletus miniato-olivaceus* var. *sensibilis,* which there is every reason to believe is the same plant which Palmer figures as *B. subtomentosus.* Every one of the five persons who ate of it was more or less affected and the life of my sister was saved only by very prompt medical attendance and the use of the strongest stimulants (subcutaneous injection of brandy and others). The symptoms were those of an intense irritant, the efforts of nature to free the system being followed by a complete collapse, from which only the strong stimulants mentioned could rouse the patient. There were none of the narcotic symtoms of Amanita poisoning. My own symptoms were similar to those of my sister, but not so severe." Mr. Webster makes a vigorous protest against the "incautious, sweeping statement" of Mrs. Rorer in the February Bulletin that "all boleti are edible." Lack of space prevents the publication in full of Mr. Webster's protest.

Experiments made by Prof. L. R. Jones with the seeds of the orange hawkweed (*Hieracium aurantiacum*) showed that when fresh 60 per cent germinated, decreasing in one year to 44 per cent, in two years to 35 per cent, in three years to 16 per cent, losing their vitality altogether in five years. This plant is one of the most dangerous weeds in many parts of New England, propagating mainly by its stolons. Salt has been found very useful in combatting this pest.

From the answers received to our questions on the distribution of golden rod it appears that *Solidago latifolia* is abundant in damp, shady woods, from New York to Illinois, while *S. rigida* is unknown or rare throughout this region, except at Peoria, Illinois, from which place Frank E. McDonald reports it common. He also inquires whether any reader has collected the rare *S. Houghtonii*, and, if so, where and under what conditions?

Observations.

Dissemination of Plants by Stock Cars.

Long Pine, Brown county, Nebraska, is a division station on the Fremont, Elkhorn & Missouri Valley Railroad, where stock shipped from all distant points west in South Dakota and Wyoming is fed and watered, usually without unloading. The stock cars are bedded with soil from western stations, and some of this is kicked out at such times. Many "empties" are wintered here also, and are cleaned out in the fall after the run is over. In this way there is a good opportunity for the dissemination of the seeds of western plants. The tracks within the yard limits are kept pretty clean by the trackmen, so that it is impossible to give a full list of plants that would grow here if left undisturbed. Some of those noted below are well established; others only seen once or twice before their destruction. I give the nearest points at which these plants are indigenous, though the seeds were brought in many instances, no doubt, from points much further west. I have not found these plants spreading to any considerable distance from the track, even those that fruit well year after year.

Sporobolus airoides. Indigenous at Alliance, 280 miles by rail northwest.

Oryzopsis cuspidata. Abundant and long established. Indigenous at Chadron, 195 miles west.

Poa nemoralis. Indigenous at Johnstown, 20 miles west, but only in canyons.

Poa laevis. In much heavier tufts than at Chadron, 193 miles west.

Puccinellia airoides. Indigenous at Crawford, in saline soil only 220 miles west.

Atriplex hastata. Indigenous at Chadron.

A. argentea. Indigenous at Chadron.

A. Nuttallii. Male plant only. Indigenous in Wyoming.

A. endolepis. Indigenous in Wyoming.

Astragalus Plattensis. Indigenous at Chadron; also 100 miles east of Long Pine on clay sub-soil.

A. adsurgens. Indigenous at Crawford, 220 miles west.

Anogra coronopifolia. Indigenous at Harrison, 250 miles west.

Musineon divaricatum. Whitney, 205 miles west.

Oreocarya suffruticosa. Rushville, 160 miles west.

In 1895 *Tribulus terrestris* was found growing in abundance on a vacant, sandy town-lot in the village of Newport, twenty miles east of here. The burs had probably clung to some boxes of goods shipped from the Atlantic coast, as the plants were near a store where such matter had been thrown out. It threatens to become as much of a nuisance as the sand burs, *Cenchrus tribuloides,* with which it now contends for the supremacy.

In May, 1896, I found a patch of *Geranium maculatum* in the canyon at Long Pine, about forty rods from any house, apparently quite at home. Whether it was introduced or is a remnant of better days will probably always remain a problem. Britton and Brown say: "Newfoundland to Manitoba, south to Georgia, Alabama and Missouri."

Last year I found *Franseria Hookeriana* abundant at Merriman, a sandy stock station 100 miles west of here. Texas cattle are shipped into that station to complete their growth on the rich grasses of Cherry county, and, no doubt, the burr-like seed was brought in their tails or hair. It would be still more strange if, in the great activities of our modern civilization, such transfers were not constantly taking place.

J. M. BATES.

A Few Ecological Notes.

Perforation of Flowers. The relation of insects to flowers is one of the most interesting questions propounded by the modern botany. Much has been written, and much remains yet to be done to clear up the doubtful points concerning the real object of the visits of insects. Lately doubt has been thrown on the general application of the law that nature abhors continuous self-fertilization, because there are many self-fertilized plants which are favored in the struggle for existence over those cross-fertilized. The violets and many other cleistogamous plants show this, as also the remarkably vigorous underground seeds of *Amphicarpaea monoica* (1). That insects are not always useful in promoting cross-fertilization is shown by their rifling flowers in forbidden ways. Prof. L. H. Pammel (2) has collected many instances of flowers pierced by insects in search for the nectar in the center. J. G. Jack (3) has also added much to our information on the subject. I wish to present a few instances which have come under personal observation.

On June 29, 1894, while walking in Woodland Cemetery, Philadelphia, where *Scutellaria pilosa* grows abundantly, I saw an humble bee at work perforating the flowers of this pretty skull-cap. Inserting his proboscis about one-half inch above the calyx and moving his head in an up and down direction, he made a slit in the outer side of the tube of the corolla about one-fourth inch long. He alighted in the usual way and apparently was too lazy to go in in the usual way, for he moved down the flower to the point where the perforation was made. This he did to a number of flowers, slitting them open along the anterior, or outer side.

Another case was observed at Sea Side Park, N. J., on September 14, 1894, where *Gerardia maritima* grows abundantly. A species of *Bombus* was found at work slitting open the brilliant flowers. I have seen holes pierced in the urceolate corolla of *Andromeda mariana*, and also in those of the rather rare plant *Obolaria virginica*, but in neither case have I ever found the marauders at work.

Ant Plants. Much has been written concerning myrmecophilous plants. The following observations made in 1894 may be of some interest to the readers of the Asa Gray Bulletin. The upper portions of several Canada thistles (*Cnicus arvense*) were found densely covered with brownish green aphids (plant lice), which were visited by ants, who were actively milking them. A beetle, resembling a rose-chafer, alighting on the plant was vigorously attacked and driven off the plant by the ants, who seemed to regard the thistles as their especial domain and the rose-chafer as an intruder. The bees on the other hand which were seen visiting the flower heads were unmolested, because the ants were shut off from the flowers by the *chevaux de frise*, formed by the projecting spines on the involucral scales. It

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1. 1897. DR. ADELINE F. SCHIVELY, *Botanical Contributions, Univ. of Penna.* I, pp. 270-360.
2. 1888. PAMMEL. *Contributions from the Shaw School of Botany.* No. 1.
3. 1892. JACK. *Garden and Forest.* V, p 29.

seems probable, that the ants chose the Canada thistle, because the plant is such an uninviting and spiny one, where the aphids would be better protected from the syrphus fly and its larva.

Insects and Flowers. Asclepias incarnata is an abundant milkweed in the brackish marshes at Sea Side Park, N. J. The flowers were visited by an humble bee that had the brushes of hairs on its posterior pair of limbs colored golden yellow and swollen to twice their usual size (in appearance) by the pollen masses (pollinia) removed from the flowers. He carried at least fifty such masses.

Fragaria virginiana. The blossoms of most plants of this species found in a field of considerable extent near the University, and along the cinder embankment of the Philadelphia, Wilmington & Baltimore Railroad were devoid of stamens and, therefore, pistillate. An occasional plant is met with, which is hermaphrodite. It is evident that the pistillate plants must be fertilized by pollen from the stamens of the perfect flowers. The plant is, therefore, polygamo-dioecious. In some cultivated strawberries, pistillate forms occur, and it is customary to plant an occasional row of staminate among the pistillate ones. I have never found in the wild plant, a purely staminate form, although it is not impossible that such may exist.

Smilax herbacea. This plant which emits a fetid carrion-like odor, was visited May 22, 1892, according to my field notes, by the common large black ant (*Formica gigas*), sipping along the margins of the petals.

JOHN W. HARSHBERGER.

University of Pennsylvania.

RECENT LITERATURE.

Report of the Botanical Department of the New Jersey Agr. Exper. Station for 1897, by Dr. B. D. Halsted, is, as usual, full of interest. Some of the principal subjects treated are: Club root of crucifers, potato scab, influence of weeds upon the soil and crops, effect of shading upon plant growth, etc.

"*Lessons with Plants*," by Prof. L. H. Bailey, of Cornell University, is a book which every teacher and student who reads the Asa Gray Bulletin will want to own. For a long time this publication has been awaited with interest, since Prof. Bailey was never known to write a dull line about plants, and few have written more on botanical and horticultural subjects than he. This is not a formal text book but a series of nature-study observations, full of suggestion and interest from cover to cover.

Not less attractive and helpful than the text are the illustrations, nearly four hundred and fifty in number, most of them having been drawn from life by Prof. W. S. Holdsworth, of the Michigan Agricultural College. They mark a distinct innovation in botanical illustration and have a delightful freshness and naturalness which no other similar work to our knowledge possesses.

If any of your students find botany prosy, get "Lessons with Plants," read it carefully and a general awakening of both teacher and pupils will follow inevitably. Our space is too limited to give an adequate review of this book, which contains nearly five hundred pages. Some of the subjects so delightfully treated are:

Knots and knot-holes, the opening of the buds, disguises of leaves, the kinships of the flower, the crossing of plants, influence of pollen upon the fruit, how a squash plant gets out of the seed, how some plants get up in the world, and plant societies.

This book may have been written at a desk, but it was thought out in the fence corner, orchard and garden, by the hedge row, and in many a woodland ramble. G. H. H.

The March number of the Botanical Gazette contains an article on collecting and preserving fleshy fungi for the herbarium, by Prof. Edward A. Burt, which is well worth the attention of all mycologists, incipient or otherwise. The directions for gathering, selecting and preparing the fungi are plain and practical and embody the results of the extended experience of a man well qualified through special study of these plants to judge as to the essentials of good herbarium material. E. M. W.

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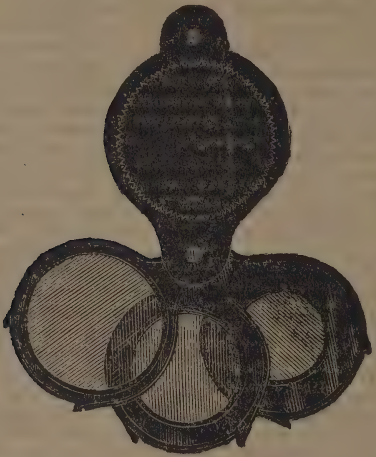

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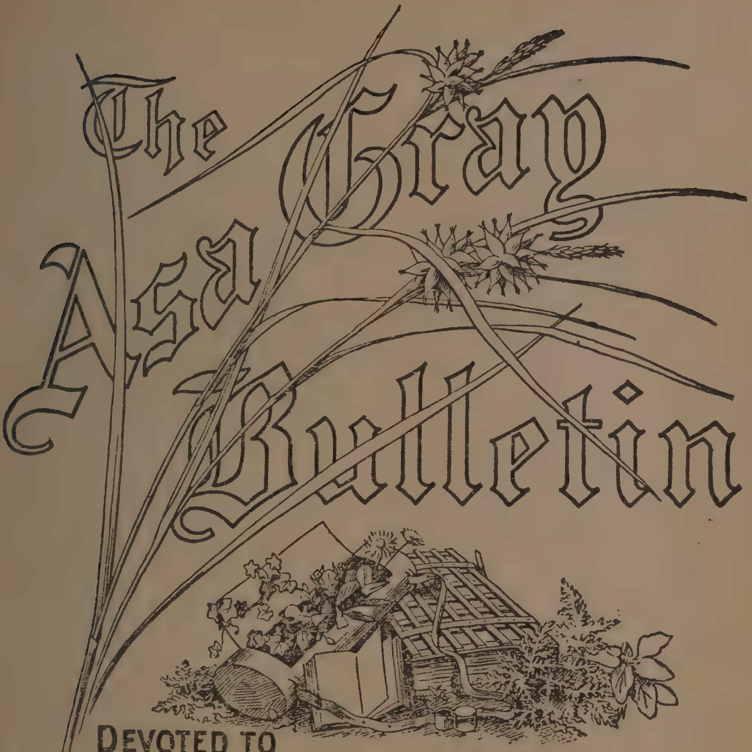

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Asa Gray Bulletin.

VOL. VI. NO. 3. JUNE. 1898. Whole NO. 26,

Inflorescence of Clintonia Borealis.

WALTER DEANE.

In pursuing the study of plants about us I think that we are apt to fall into a mistake, natural enough perhaps, but at the same time likely to mislead and to give us a false idea of the great law that governs the plant world in the structure of the flowers, the number of petals and sepals, the kind of inflorescence and the like. We are too much inclined, it seems to me, to take some character that is most common, call that the rule and then say that if the plant exhibits any deviation it is rather abnormal, it is not what it should be. Now, we all know that nature never works in straight lines and we must never expect to find them. In the great and grand evolution of the plant kingdom one form has gradually and imperceptibly glided into another. Where the connecting links have disappeared, there we find distinct forms, but in thousands of instances this is not the case, and intermediate forms exist. These transitional form are perfectly s/ normal in themselves, though often difficult of classification, but they are of the greatest interest to the student of evolution.

In some particular species, for instance, the inflorescence may be in the main umbellate, but if it constantly exhibits departures from this, showing forms of a more primitive or advanced type, surely that is but natural, and the systematic botanist must make provision, in drawing up his description of this species, for these outlying forms. I will illustrate what I mean. In the botanical museum of Harvard College is that wonderful collection of glass models of flowers, made by Leopold and Rudolph Blaschka,* where the most marvellous genius and power of copying nature have been shown in a manner that is almost beyond belief.

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*See Bot. Gaz., XIX. 144-148, and Harvard Graduates' Magazine for July, 1893.

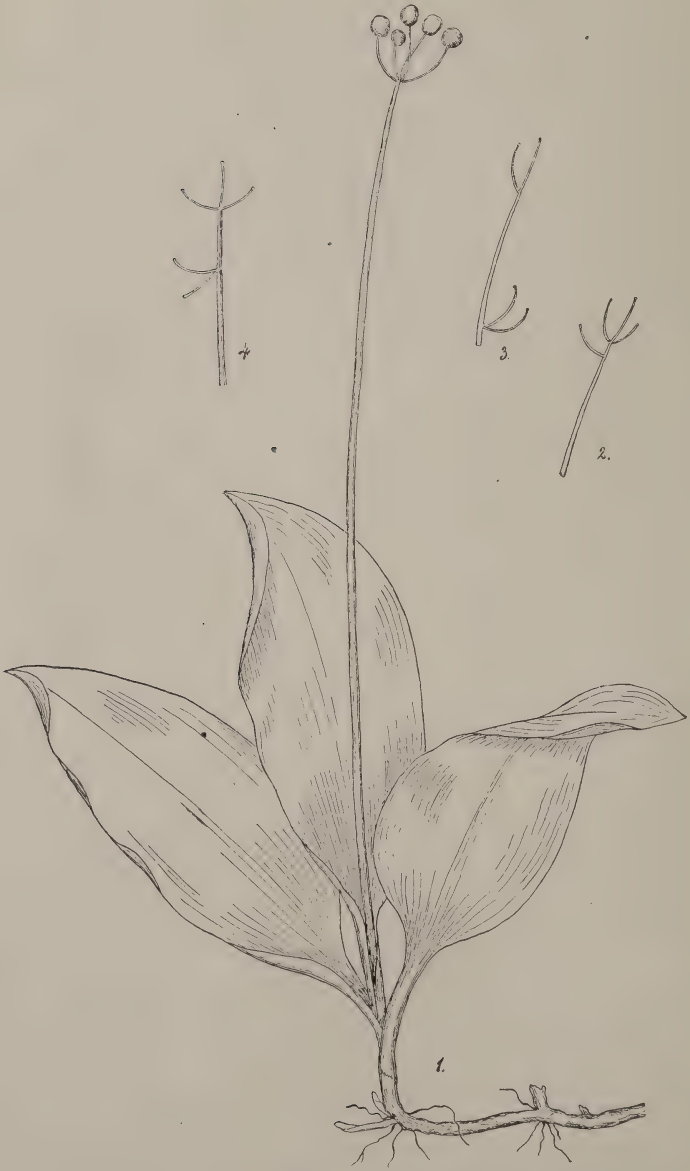

Fig. 10. INFLORESCENCE OF CLINTONIA BOREALIS.

1, Normal plant.
2, 3, 4, Unusual inflorescence.

Among the various specimens is one of *Clintonia borealis* that has a curious inflorescence. With scarcely an exception, if indeed there be any, in our botanies this inflorescence is described as umbellate, and hence any deviation from that plan would seem to be quite wrong. Now, the plant in question, deftly made in glass, does not bear an umbel, but the flowers are on the sides of the scape, one above the other. Here was room for criticism. I noticed it one day, in 1894, while making a careful examination of the botanical accuracy of these flowers, where I found astonishing results, showing the most conscientious following of every detail. I could not believe that here could be so bold an error, while in the case of flowers which I had to examine with my lens, I found all the parts exactly as they should be. It was in the winter time and I could get no fresh plants, so first I consulted various herbaria, and I succeeded in finding a plant with an umbel on the top of the scape, and a single flower on a pedicel of the usual length about an inch below. That looked encouraging. Then consulting Bentham and Hooker's "Genera Plantarum" I found that sometimes flowers were scattered below the umbel. These great botanists recognized the fact that it would not do to characterize the inflorescence as strictly umbellate. Nature used no hard and fast lines in this species apparently.

Shortly after this it was my good fortune to meet Mr. Rudolph Blaschka at my house. In the course of our conversation I introduced the subject that was naturally on my mind, and I received the following interesting reply: Mr. Blaschka said that his father, Leopold, had made this model from a living plant raised in their own garden in Germany from roots taken over from this country. He himself was absent from home at the time, and when afterwards he saw his father's model, he called him to task for it. Mr. Leopold Blaschka replied that he had copied the plant in every particular, just as it was growing. Next spring the plant would tell its own story. The spring came, the Clintonia burst into bloom, and its inflorescence was an exact duplicate of the model made the year before. It gave me the greatest satisfaction to hear this story, and I made up my mind to look the matter up the following summer.

On July 28th, 1895, in Whitefield, N. H., I went into the rich woods near the house and came upon a patch of fruiting Clintonia covered with beautiful blue beries. I picked at random a handful of scapes and took them back to the house with me. There were forty-eight in all, and of these eight had one or two pedicels on the scape some distance below the umbel; that is sixteen and two-thirds per cent. of the number of stems gathered.

Later in the same year, on Sept. 21st, at Wells, Maine, I found in the woods a patch of Clintonia some twenty feet square. In three or four minutes I gathered thirty-one stems, all of which deviated from the typical umbellate form of inflorescence. I selected these more unusual forms purposely, but the short time it took me to gather so many shows how abundant they must have been. In nineteen cases one pedicel, and in eleven cases two pedicels were an inch or so below the umbel, one pedicel being an inch and a half below, while in one case three pedicels grew from the same point on the scape about an inch below the umbel.

This satisfied me; we have no right to expect to find only perfect umbels in this species, and we must consider the so-called aberrant forms quite as normal as the strictly umbellate forms, and characterize the species so as to include these varying phases. This, as I take it, applies very widely to the plant kingdom and while for convenience of classification we assume some form as a center we must pay careful attention to the variations on either side of that center and remember that even no two individual plants can ever be exactly alike.

Botany in the Nebraska High Schools.

CHARLES E. BESSEY.

In order that other botanists may be encouraged to labor for a better teaching of Botany in the High Schools, it may not be amiss to tell what has been accomplished in the still young State of Nebraska. At the outset, it must be remembered that in this State the school system, beginning with the lowest primary grades, is continuous through the High Schools to the State University. Thus it is considered to be the normal function of the High School to fit its pupils to enter the State University. From this condition there has arisen a close and harmonious relationship between the schools and the University, which has been most helpful in the introduction of the better methods of instruction.

A dozen or so years ago, the botanical instruction in our High Schools was very poor, indeed, consisting mostly of mere text-book work (the books antiquated, and not suited to this region) with little or no field work. The first effort at improvement sought to drive out the unfit books and to bring into the study a good deal of field work. The teachers were shown how to properly prepare herbarium specimens, and how to mount and label them properly, in order that in turn they might give proper instruction to their pupils. Then the teachers were encouraged to broaden the work so as to have it include the collection of lower plants, as the pond scums, green slimes, fungi, lichens, mosses, etc. This led quite easily to the use of the compound microscope, at first for demonstration in the hands of the teacher and then as a laboratory tool in the hands of the pupils themselves.

The present standard of High School Botany may be understood from the directions given in the new edition of the "Nebraska High School Manual," recently issued by the State University, and the State Department of Education.

It is recommended that one year be given to Botany. The laboratory requires a good light, preferably from the north sky, and must be supplied with firm tables twenty-seven or twenty-eight inches high, and the accessory wall cases and shelves for specimens and apparatus. The microscopes must be from some good maker, with powers ranging from seventy-five to six hundred diameters. Directions are given regarding the purchase of microscopes and other apparatus.

Particular directions are given as to the ground to be covered, as follows:

The pupil should study such selected plants as will give him a general outline of the Vegetable Kingdom, including a fair knowledge of the principal types of plants, and the modifications they have undergone. For this purpose the following plants are recommended:

1. One or more protophytes, from the following list: Chroococcus, Oscillaria, Nostoc, Bacillus.
2. Several green seaweeds from the following: Protococcus, Spirogyra, Vaucheria, Cladophora, Oedogonium, and their degraded relatives Mucor, Albugo, Peronospora, etc.
3. At least one of the brown seaweeds: Laminaria or Fucus.
4. At least one of the red seaweeds: Polysiphonia, Plocamium, or Corallina.
5. Several sac-fungi, from the following lists: (a) Erysiphe, Microsphaera, Podosphaera, etc.; (b) Plowrightia, Peziza; (c) Puccinia, Ustilago.
6. Several higher fungi, from the following lists: (a) Lycoperdon, Secotium, Ithyphallus; (b) Agaricus, Polyporus, Stereum.
7. At least one of the mosses: Mnium, Bryum, Timmia, Funaria or Hypnum.
8. At least one of the fernworts: Asplenium, Cystopteris, Pteris, Equisetum, Lycopodium or Selaginella.
9. At least one of the gymnosperms: Pinus, Larix, Abies or Picea.
10. At least six angiosperms, as follows: (a) two monocotyledons, one of which has superior ovaries, as Alisma, Trillium, Lilium, Erythronium, etc.; the other with inferior ovaries, as Iris, Amaryllis, Orchis, Spiranthes, etc.; (b) four dicotyledons, one with superior ovaries and choripetalous corolla, as Ranunculus, Capsella, Viola, Silene, Callirrhoe, Geranium, Potentilla, Fragaria, Astragalus, etc.; another with superior ovaries and gamopetalous corolla, as Primula, Steironema, Phlox, Hydrophyllum, Lithospermum, Ipomoea, Physalis, Pentstemon, Mentha, Salvia, etc.; a third with inferior ovaries and choripetalous corolla, as Epilobium, Oenothera, Mentzelia, Opuntia, Aralia, Cornus, Daucus, Pastinaca, Osmorrhiza, etc.; and a fourth with inferior ovaries and gamopetalous corolla as Sambucus, Viburnum, Houstonia, Galium, Campanula, Vernonia, Aster, Helianthus, etc.

In the foregoing work the pupil should get some idea of the structure of the whole plant. He should learn enough of the technical descriptive terms so that he can give intelligent descriptions of each plant. At every stage of the work the pupil should be required to make careful drawings in his note-book, accompanied by concise descriptions of essential characters.

In addition to the foregoing it is recommended that every pupil should have some practice in the collection and preservation of specimens, for which full directions are given. High Schools are urged to provide a few books for a reference library, as follows:

General Works:
- Arthur, Barnes and Coulter's Plant Dissection ($1.25).
- Bessey's Essentials of Botany ($1.25).
- Goebel's Outlines of the Classification of Plants ($6.00).
- Gray's Structural Botany ($2.00).
- Kerner and Oliver's Natural History of Plants ($15.00).
- Prudden's Story of the Bacteria ($0.75).
- Sach's Text-book of Botany ($6.00).

Physiological Works:
- Goodale's Physiological Botany ($2.00).
- Johnson's How Crops Grow ($1.50).
- MacDougal's Experimental Plant Physiology ($1.00).

Systematic Works:
- Botanical Seminar, Flora of Nebraska ($3.00).
- Britton and Brown's Illustrated Flora of the Northern States and Canada ($9.00).
- Coulter's Manual of the Botany of the Rocky Mountain Region ($1.65).
- Gray's Manual of Botany, sixth edition ($1.65).

Shorter Articles.

Do Humble Bees Perforate Tubular Flowers?

I read with much interest the "Ecological Notes," on page 37 et seq. of the April *Bulletin*, but from past personal experience I was lead to doubt whether it was really a species of Bombus which was the guilty party; and wrote to Dr. Harshberger to know. Luckily he had kept the insects which he had taken in the act of slitting the flowers of *Scutellaria pilosa*, and on examination finds them to be the Carpenter Bee (*Xylocopa Virginica*). This corresponds to my own experience in this regard. For more than twenty-five years I have been making observations on the mutilation of flowers by insects; and at first thought it was the humble bees or *Bombi* which did the work; and so published it in an early number of the *Botanical Gazette.* But more thorough determinations demonstrated that it was not one of the humble bees, but the Carpenter Bee which had slitted the flower tubes.

I have a long list of plants on which I have found this insect doing this work, including, besides nearly all of the tubular flowers found here, many of the leguminosae, *Bicuculla* (*Dicentra*) *cucullaria*, *Dicentra spectabilis*, and other irregular-shaped flowers. I have observed the humble bees visit these same flowers many thousand times and they invariably entered them in the regular way, through the mouth of the corolla; while the Carpenter bees as constantly slit the corolla near the base; even in so large and roomy flower as *Tecoma radicans.* The honey bees have become aware of this fact and often take the nectar through the slits made by the carpenter bees; if they fail to find such a slit they turn and enter the corolla tube at the mouth.

DR. J. SCHNECK.

Mt. Carmel, Ill.

Albino Flowers.

Last summer I became much interested in the many white specimens I found of flowers usually of a different color, and so kept a list of them, adding those of other years, and some that had been found by friends. Here is the list:

Cnicus discolor, Gray; *Cnicus arvensis*, Hoffm; *Brunella vulgaris*, L.; *Viola pedata.* L.; *Viola cucullata*, Gray: *Trifolium pratense*, L.; *Sabbatia stellaris*, Pursh.; *Desmodium Canadense*, D. C.; *Eragrostis pectinacea*, Gray.; *Sisyrinchium angustifolium.* Mill.; *Cichorium intybus*, L.; *Raphanus raphanistrum*, L.; *Vinca minor*, L.; *Lupinus perennis*, L,; *Cypripedium acaule*, Ait.; *Aster linariifolius*, L.; *Gentiana crinita*, *Froel.*

I had several plants of *Viola pedata* with the pure white blossoms, even the lower petals having not a single dark mark upon them. At the same time and from the same locality I had three or four plants of *V. pedata* with bright pink blossoms, and in each plant the petals were much more narrow than in the normal. The leaves, too, showed a marked difference from those of the ordinary plant, the leaflets being much more slender and delicate. In the white specimens the petals and leaves were normal in shape. Several years ago I found in Massachusetts, a patch of *Viola cucullata*, perhaps two feet square, all bearing the white blossoms. In *Vinca minor*, this color seems to be not uncommon.

The specimen of *Cypripedium acaule*, of which there was but one, was a beauty. *Desmodium Canadense* with white blossoms was found by a friend a few years ago, but only a single plant.

In *Eragrostis pectinacea*, all the panicles were of a distinct creamy white color, making a marked contrast to the purple of the neighboring plants.

Of *Trifolium pratense*, I found only one white head. I found but one plant of *Cnicus discolor*, but it had many blossoms, all white.

Perhaps other members will be able to add more to this list.

FRANCES M. GRAVES.

New London, Conn.

(I once had a note from Asa Gray in response to a letter on this subject, in which he said it might be necessary to add to the Manuel "Look for a white flowered form of every species.")

C. G. Du BOIS.

While on a collecting trip to the vicinity of Elizabeth, N. J., recently, I found several specimens of *Oakesia sessilifolia*, Watson, having pure milk-white flowers instead of yellowish flowers.

Neither Gray nor Britton mentions this fact, and as I have never observed them before, I consider them as rare, at least in this vicinity.

WM. H. McDONALD.

New York City.

Cleistogamous Flowers on Solea Concolor.

It is well known that several species of violets produce closed flowers, and it is not surprising that Solea does. Yet I am unable to find that fact has ever been mentioned. The plant is rare in this locality and seldom fruits. I transplanted one to the garden six years ago and although it has grown luxuriantly and flowered freely about the middle of May, it rarely fruits. The plant has always interested me, and I seldom failed to pay it a visit when I enter the garden. It has never produced closed flowers until the past summer. About the middle of August I noticed fruit pods at the summit of the stems and on examination they proved to be from closed flowers. The apex of the stem had lengthened somewhat and the young leaves were crowded at its summit, in the axils of these, standing erect, were the flowers. Later in the season they extended to several internodes below, one to three of these flowers in the axils of the older leaves, appearing near the pedicels of the earlier flowers or fruits, and even about the present fruit. The flowers were smaller than the earlier ones, but complete and symmetrical, the lower petal similar to the others, the lower stamens glandless, and the anthers covered the stigma; the anthers were yellow and all pollen bearing. The pedicels in fruit were shorter and thicker than those of the earlier flowers, but the capsules were of the same size, and each contained on an average eight well-developed seeds, instead of nine, the usual number. As the frosts last fall were unusually late in appearing, the plants continued to flower till the last of October. I have specimens collected October 24th bearing buds, flowers and fruit.

EMMA J. COLE.

Grand Rapids, Mich.

Determination of Sex in Arisaema Triphyllum.

Prompted by an article in the *Asa Gray Bulletin*, Vol. IV., No. 1, regarding the approximate determination of sex by the size of the blossoms, I examined numerous specimens this season with the following result:

May 16, small, green, staminate, 3; small green pistillate, 0; medium green staminate, 5; medium green pistillate, 2; large green staminate, 1; large green pistillate, 0; small purple staminate, 13; small purple pistillate, 2; medium purple staminate, 13; medium purple, pistillate, 10; large purple staminate, 1; large purple pistillate, 10.

Total: Green staminate, 9; green pistillate, 2; purple staminate, 27; purple pistillate, 22.

In one instance two of equal size were so close together as to seem at first glance united. One of these was pistillate, the other staminate. In another case the larger of a pair was fertile, the smaller sterile. All four were purple.

May 23, small green staminate, 17; small green pistillate, 6; medium green staminate, 23; medium green pistillate, 11; large green staminate, 3; large green pistillate, 9; small purple staminate, 18; small purple pistillate, 1; medium purple staminate, 48; medium purple pistillate, 20; large purple staminate, 4; large purple pistillate, 11.

Total: Green staminate, 43; green pistillate, 26; purple staminate, 70; purple pistillate, 32. Besides I found two purple ones with both stamens and pistils; one was of medium size, the other small.

From the above it would seem that Dr. Torrey's rule, "the green ones are staminate while the purple ones have pistillate flowers only," does not hold good. That suggested by Miss Schlegel in the article above referred to, viz: That the large specimens are pistillate, the small ones staminate, though its originator does not claim for it infallibility, seems to be at least nearly enough constant to deserve consideration.

It will be seen that in specimens examined the majority of the large flowers were pistillate; the larger portion of the medium and small ones, staminate. Of the six small pistillate green ones found on the last excursion, four grew in a compact clump and were almost covered with their own foliage.

While a positive rule for the determination of sex is evidently yet to be found, I believe that the very largest and most conspicuously mottled ones are almost always fertile. I found no exception after making this division, which was not, however, until about half of the last trip was made. I now recall the fact that by far the largest one with the most distinctly mottled stem that I ever saw was found last autumn in fruit. I searched for it again this year, but was either mistaken as to its location or it is dead. At least I failed to find it.

BESSIE L. PUTNAM.

The Indian Plantain.

I wonder if *Asa Gray Bulletin* readers admire, as I do, the stately beauty of the Indian Plantain (*Cacalia reniformis*). It is a denizen of rich, dark woods, growing fully eight feet high, and bearing at the summit its corymbs of creamy white flowers. It seems to me a most striking plant, and one well worthy of cultivation. It has been noticed at but two stations in our vicinity, and I am at loss to account for its being, seemingly, rather local, producing as Compositae do, such an abundance of seeds. Dr. Davis of this city, in connection with some experiments in the realm of parasitic fungi, attempted to grow this plant from seed, but not a single one of the seeds germinated. This added to the fact of its scarcity, has led us to question, if, like the Orchidaceae, the seeds are not in great measure abortive. We intend to pursue our investigation in this direction and it might be of interest, if other collectors would also experiment a little and report results.

On the prairie near by, I have collected *Cacalia tuberosa*, less stately and imposing than *C. reniformis*, and farther to the north, in the next adjoining county, are the haunts of the Pale Indian Plantain (*Cacalia atriplicifolia*), another very handsome species.

S. C. WADMOND.

Racine, Wis.

Editorial.

Nature Study in Schools.

A most admirable feature of instruction in some of our public schools has been growing in importance within the past two or three years. We refer to the nature study of plants. To Dr. W. J. Beal of the Michigan Agricultural College and Professor L. H. Bailey of Cornell University the country is largely indebted for this movement. Until within comparatively recent times almost the only botany taught in our secondary schools consisted in the identification, with the aid of a teacher and a manual, of a few of the common plants of the neighborhood. This was generally followed by the preparation of a so-called herbarium in which the underground and fruiting portions were usually conspicuously wanting.

Some interest was thereby awakened, and in rare instances, a botanist or two resulted, this, however, in spite of the barbarous method of study. Probably not one pupil out of a hundred knew anything important about the living plants he identified, and the principal object of botanical study, a real love for plant life, was nipped in the bud. Unfortunately this system of instruction(?) is far from obsolete at present, but it is refreshing to note that it is gradually passing away.

The average pupil in European public schools knows a great deal more about plants than American pupils of the same age. This is due partly to the gardens which are a common accessory to many public schools abroad. In a single province in Southern Russia, for example, out of 504 schools, 227 have gardens, comprising an area of nearly 300 acres. In 1895 these gardens contained 111,000 fruit trees and 238,300 planted forest trees. The culture of trees, vines, grains, garden plants, silkworms and bees is taught by the common school masters. Even many of the primary schools in small villages have small orchards and kitchen gardens. From this state of things to an interest in native plants is but a step.

The Horticultural Society of Massachusetts offers money prizes to school children for gardens of wild plants. District schools in other parts of the country, notably in New York and Michigan, are starting similar gardens. There is certainly much more to be learned from growing wild plants than from pressing dead ones, although the latter phase of elementary botany is not to be decried of course, if it is properly done, and as an accompaniment of the former.

The Agricultural Experiment Station at Cornell is issuing teacher's leaflets for use in the rural schools. The following titles of some of these leaflets, which are attractively illustrated, indicate the nature of the work: "A Children's Garden," "Four Apple Twigs," "How a Squash Plant Gets out of the Seed," "Our Common Oaks." Similar leaflets are being issued by the Michigan Agricultural College. We commend this movement most heartily, and advise any of our readers who may be interested to write Mr. Jno. W. Spencer, 18 Morrill Hall, Cornell University, Ithaca, N. Y., for sample leaflets on nature study, which include insects and natural philosophy as well as plants.

Notice to Our Readers.

We would like to print articles upon any of the following subjects: Succulent plants; Cleistogamy in plants; Plant glands; The nature and significance of nectar; Native climbing plants; Stipules, their morphology and functions; Variations in plants due to environment; Roots of native orchids, their morphology and anatomy; Germination of spores in some group of fungi; Aquatic mosses; The structure of lichens; Puff balls; Germination of spores of ferns; Observations upon the growth of fleshy fungi; Plant photography. A year's subscription to the *Bulletin* and a complete set of volume V will be given to the writer of the best article upon any of the above subjects sent to the editor before September first. Good ink drawings will count largely in this offer. Set your students at work this summer upon some of these lines of study, or make a contribution of your own.

News and Notes.

Owing to a pressure of other work our efficient business manager, Mr. L. H. Dewey, has resigned as business manager of the *Bulletin.* Hereafter all communications, business or otherwise should be addressed to *The Asa Gray Bulletin*, Washington, D. C. Mr. Dewey will continue his interest in the *Bulletin* and assist in the literary part of the work.

Mr. Adam Steitz, of Baltimore, Md. sends us six photographs of native orchids, which we have fastened to their proper sheets in our herbarium, thereby greatly adding to their value. We would be glad to receive short articles or notes from any of our readers recounting their experiences in photographing plants.

An English translation of the Lehrbuch der Botanik, by Strasburger, Noll, Schenck and Schimper, reviewed in the *Bulletin*, Vol. V, No. 1, has just been issued by MacMillan & Co.

The Gray Memorial Botanical Chapter has elected the following officers for 1898: President, O. A. Farwell, 1225 Jefferson ave., Detroit, Mich.; Treasurer, Geo. P. Ells, Norwalk, Conn.; General Secretary, Miss C. G. DuBois, Waterbury, Conn., (absent for the summer in California); Executive Council, Theo. G. White, Columbia University, New York City, W. H. McDonald, 2297 First ave., New York. During the absence of Miss DuBois in California, Jas. A. Graves, Susquehanna, Pa., will serve as General Secretary pro tem.

The Pennsylvania Mycological Society, Elizabeth W. Hunt, M. D., 4809 Trinity Place, West Philadelphia, Secretary, meets every Friday at 3:30 P. M. at the Academy of Natural Sciences, Philadelphia. This club has twenty-four members, makes weekly collecting trips and would be glad to receive visitors from any members of similar clubs, also to exchange specimens.

Mr. S. C. Wadmond, Racine, Wis., offers to send an herbarium specimen of that rare orchid, *Cypripedium candidum*, to any subscriber of the *Bulletin* who will send four cents in stamps to defray postage. Mr. Jas. A. Graves, Susquehanna, Pa., continues his generous offer to send a package of sedges to subscribers sending him five or ten cents postage, the latter amount securing a larger package.

A monument is about to be erected to the memory of Baron Ferdinand von Mueller, the celebrated Australian botanist. Small subscriptions are asked from botanists whose names will be published with the biography of the Baron soon to be issued. Rev. W. Potter, Arnold st., South Yarra, Melbourne, Australia, will receive any sums designed for this purpose.

The fiftieth meeting of the American Association for the Advancement of Science will occur at Boston, Mass., August 22-27 1898. Dr. W. G. Farlaw of Harvard University is Chairman of Section G (Botany), and Dr. Erwin F. Smith, U. S. Dept. of Agriculture, Washington, D. C., is Secretary. Write to the latter for a programme of the botanical papers to be presented, if you expect to attend. Interesting excursions have been planned, and a fine meeting is anticipated.

Mr. C. L. Shear, formerly President of the Gray Botanical Chapter, and until recently botanical assistant in the University of Nebraska, has been appointed an assistant agrostologist in the U. S. Department of Agriculture.

We commend to the careful attention of our teacher-readers the article by Dr. Bessey in this number. Dr. Bessey is well known as one of the most successful teachers of botany in America; his text books, "Botany for High Schools and Colleges," and "Essentials of Botany" are used throughout the country.

The U. S. Fish Commission will make a scientific investigation of the food habits of the fish of Lake Erie during July and August, with headquarters at Put-in-Bay. Mr. A. J. Pieters accompanies the expedition as botanist.

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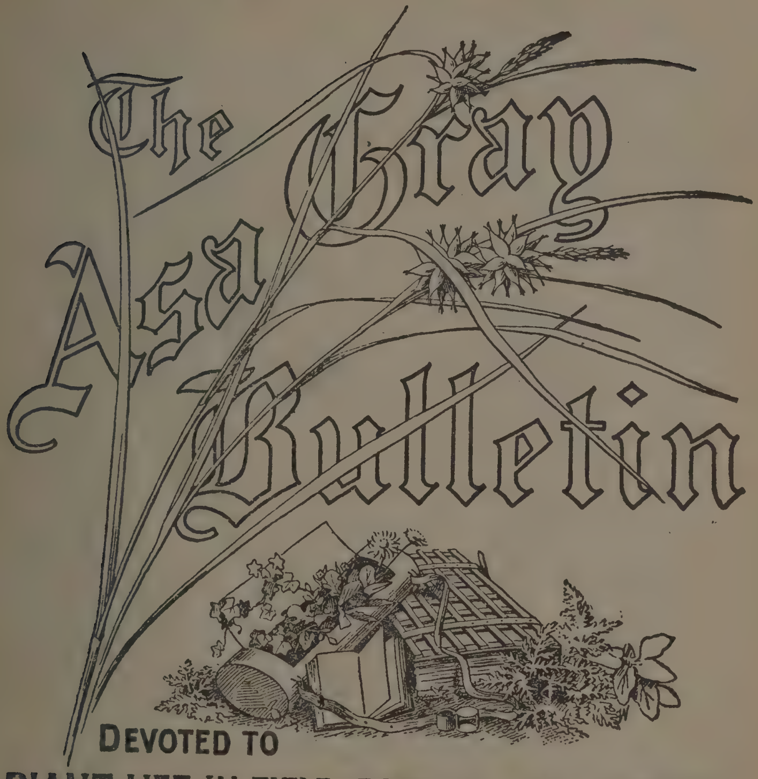

DEVOTED TO

PLANT LIFE IN FIELD, FOREST AND GARDEN.

EDITOR:

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Asa Gray Bulletin.

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Three Common Lepiotas.

MRS. E. M. WILLIAMS.

The genus *Lepiota* is an attractive one to study since it contains some of the most beautiful as well as one of the most remarkable of the mushroom family. It belongs to the white-spored group, and in appearance is something like the Amanitas, having the same broad collar and enlarged base, but with the

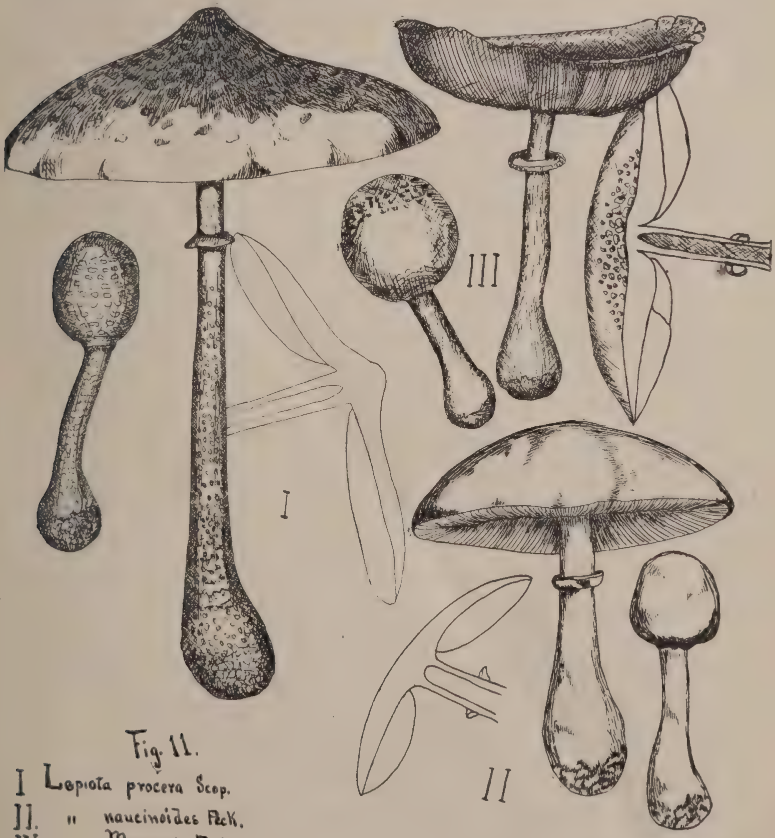

Fig. 11.
I Lepiota procera Scop.
II. " naucinoides Peck.
III. " Morgani Peck.

remarkable difference that the enlargement at the base is simply a part of the stem, while in the Amanitas it is a cup or socket. The genus contains quite a number of species, some large and a few very small ones. Three of the larger ones are quite common here at this season of the year, and to them we will turn our attention.

"The Parasol Mushroom" (*Lepiota procera* Scop.) is perhaps the most striking and certainly the best known. It is probably the tallest mushroom that grows. It has a slender stem and graceful proportions. The cup is reddish-brown, round when young, but soon spreading out into a broad umbrella-shaped top with quite a prominent umbo in the center. The skin breaks into fragments which seem to recede from each other as the cap grows, hence the color of the mature plant is much lighter than when it is young, the portion directly under the epidermis being of a dirty white color. The gills are white or yellowish, and do not reach to the stem. They are very broad, especially towards the edge of the cap. The stem is long, very slender, hollow and tapering upward from a bulbous base. Near the top of the stem is a rather broad annulus which is almost always loose and can be moved up and down. The stem is often covered with spots, sometimes described as "snaky," though this is not a permanent characteristic. The flesh is soft, white and dry. It is seldom much eaten by insects and has a pleasant, though faint odor, two good recommendations for a mushroom. It occurs quite generally, but is seldom found in great abundance. It has long been highly esteemed by fungus eaters. In an old English book occurs the following note concerning it: "It grows in pastures and is known by its long bulbous spotted stem, by the ring that will slip up and down, by the very scaly top, and the gills far-removed from the stalk at its insertion. When the stalk is removed a large, hollow socket remains—just the place to insert a large piece of butter in the broiling process, when, with pepper and salt, it forms a dish that if once tried must please the most fastidious."

"The Smooth Lepiota" (*Lepiota naucinoides* Peck) while not as stately as its relative is very attractive and will doubtless prove more useful on account of its greater abundance. It is much like the common mushroom in outward appearance, and in its place of growth, but is of lighter color and remains so in cooking, which gives it a much neater appearance when served. The cap is very soft and white, or nearly so. It has regular outlines, and is almost uniform in color, the center of the cap occasionally being slightly darker. The gills are white, free and broader toward the outside of the cap. When they are fully mature they sometimes become yellowish, and when old are generally of a dirty, pinkish white. The stem is white also and about as long as the cap is broad; it is hollow, somewhat thickened at the base and has a moveable ring. The whole plant is shorter and broader than the preceding, being from 2 to 4 inches broad and with the stem two to three inches long and from $\frac{1}{4}$ to $\frac{1}{2}$ in. thick, while the "Parasol" is from 3 to 5 inches broad in the cap, and has a stem 5 to 10 inches long and from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick.

It is to be found in meadows and on lawns, and generally is abundant when found. It is easily preserved by canning, and is quite attractive in appearance put up with water and salted in ordinary fruit jars.

The third of our common Lepiotas, "Morgan's Lepiota" (*Lepiota Morgani* Peck) is most remarkable of all, and may be easily distinguished from all other mushrooms by its green spores, a character not known to occur elsewhere in the mushroom family. It often attains a diameter of from 8 to 12 inches, and is sometimes quite abundant in grassy lawns after heavy rains. The pileus is soft, fleshy, slightly umbonate, sometimes becoming depressed at maturity. The thick cuticle breaks up into scurfy patches, which are denser toward the center and remain on the top. They are of a yellowish-brown, while the flesh beneath is almost white. The lamellae are free and remote from the stem; are greenish-white, becoming darker as the spores mature. The stripe is hollow, has a few scales, is sometimes spotted, and is furnished with a broad ring. The spores, when fresh, are of a bright green color, which, however, fades considerably in drying. The stipe is generally slightly longer than the cap is broad, sometimes much longer.

This mushroom is seldom eaten by insects, has a pleasant smell and taste, but unlike the others is not to be trusted. Serious cases of illness have been caused by eating it, illness of such a nature as would lead one to suspect the presence of an active poison not unlike that of *Amanita muscaria*. The poison seems to be somewhat dissipated in cooking, though little is definitely known of its properties. Some claim to be able to eat the fungus, when cooked, without harm, one case being reported of a man who could eat it safely while his wife, who partook of the same dish, was made very sick. It is undoubtedly a good mushroom for beginners to let alone.

Three Fluvial Flowers and Their Visitors.

John H. Lovell.

Aquatic plants are often of more than usual interest from exhibiting primitive or reversionary forms. In the Nymphaeaceae, or water-lilies, we meet with dicotyledonous plants resembling monocotyledons in the structure of the leaf and root-stock. The analogous arrangement of the fibro-vascular bundles in a *Nymphaea* and a *Tradescantia* has been excellently figured by de Bary. On the other hand *Sagittaria* presents us with a monocotyledon with netted-veined leaves. Both of these families doubtless point back to the primordial stock before the two great divisions of the angiosperms were fully differentiated.

NYMPHAEA ADVENA. LARGE YELLOW POND LILY.

Throughout the summer the numerous broad shining leaves and large yellow flowers form a well-known characteristic in the vegetation of ponds and slowly moving streams. That the flowers may float safely upon the surface of the water the sepals are thickened and concave, never expanding widely, with their edges overlapping and closely applied to protect the inner organs from moisture. The six sepals are unequal, the three inner are large and bright yellow, the three outer and smaller are wholly or partially green exteriorly though the upper half is often yellow, while the interior lower portion is reddish purple, probably due to oxidation since it can be of no attractive value for gaining the attention of insects. The transition from green to yellow is well shown in this flower, while the change from green to white may be observed in the involucre of *Cornus Canadensis* L.

The numerous petals are thickish, short, truncate, wedge-shaped bodies which serve as honey-glands. They are inserted on the receptacle with the stamens. The honey is freely secreted on the outer side near the top, the nectariferous portion being orange-yellow. Under a microscope both large and minute drops can readily be seen. The pistil is compounded with a broad many-rayed crown-shaped stigma, as in the poppy. No insect can pass in or out of the flower without coming in contact with its surface. When the insect comes from another flower cross-fertilization is necessarily effected, and this foreign pollen probably prevails over that of the flower itself. According to Henslow (Self-fertilization of Plants, p. 349), some species of Nymphaeaceae are self-sterile while others are quite self-fertile. In four flowers the numbers of rays was 14, 15, 16 and 19 respectively. The stamens are indefinite, arranged in five or six rows and lie in part beneath the stigmatic disk. The slender whitish anthers are more than half the length of the stamen and adherent to the inner margin of the connective, which is continuous with the filament. They open by a suture along their entire length. The filaments are broad, thin and flat.

The first indication of approaching maturity is the appearance of an opening in the bud, sufficiently large to admit a bee. At this stage I have found the stigma in a receptive condition while the stamens still formed an erect, coherent mass. As the outer anthers mature they are reflexed by the bending of the broad thin filament to a right angle near the base. The stamens are slightly elastic and if when nearly ripe are touched with a needle spring outward several millimeters, finally moving downward and resting upon those previously reflexed. This change in the position of the anthers is a provision against self-fertilization. There is thus during inflorescence two rings—one of reflexed pollen-loaded anthers and one of erect immature anthers.

Owing to the partially closed condition of the flowers it is impossible to determine by inspection whether there are insects present or not. My method is to close the flower quickly and place it in the cyanide jar, reserving until later an examination of its contents. Great numbers of the small fly *Hilara atra* revel in the pollen, but so far as observed never feed upon the honey. They are by far the most numerous visitors and their bodies are completely covered with pollen. The honey proves attractive to larger diptera, coleoptera and small bees.

Visitors: A. Diptera—(*a*) *Empidae*: (1) *Hilara atra* Loew, very abundant, feeding on pollen; (*b*) *Syrphidae*: (2) *Eristalis bastardii* Macq.; (3) *Helophilus conostomus* Will.; (*c*) *Cordyluridae*: (4) *Hydromyza confluens* Loew, rare. B. Coleoptera—*Chrysomelidae*: (5) *Donacia piscatrix* Mac.; (6) *Donacia rufa* Say. C. Hymenoptera—*Andrenidae*: (7) *Halictus nelumbonis* Rob. f, under side covered with pollen. July.

SAGITTARIA LATIFOLIA. BROAD-LEAVED ARROW-HEAD.

In this locality this species is dioecious. The location of the honey may be determined by noting the behavior of insects. In the pistillate flowers it is sought at the base of the perianth, and in the staminate flowers in the center of the stamens; the aborted stamens and pistils apparently serving for its secretion. The ovaries are many, crowded into a nearly globular depressed head, the stigmas are composed of a few slender papillae. The stamens are about forty in number, inserted rather loosely upon the convex receptacle. The anthers are large spade-shaped disks opening along their edges, which curve outward so that the pollen is more effectively brought in contact with the bodies of insects.

The plants with their excessively variable arrow-headed leaves guard the borders of our eastern streams from Canada to Florida. The flowers are whorled in threes with white petals. They prove attractive to a large company of diptera. Large insects alight directly upon the center of the flower, while smaller species often rest first upon the petals and approach from the side. It is evident that the separation of the sexes is here advantageous since the smaller insects would accomplish self-fertilization. In the staminate flowers the globular mass of yellow stamens is brought into strong relief by the white petals and attract many yellow-banded flies. Of the Syrphidae collected ten species are marked or banded with yellow. Insects of this family are strongly attracted by yellow coloration, and no doubt the development of the yellow body markings is due to sexual selection. Coleoptera are rare with the exception of *Listronotus appendiculatus.* This species is common both upon the flowers and leaves and I have never met with it elsewhere. No lepidoptera have been seen and visits of the long-tongued bees are rare.

Visitors: A. Diptera—(*a*) *Syrphidae*: (1) *Melanostoma mellinum* L.; (2) *Eristalis transversus* Wied.; (3) *Eristalis bastardii* Macq.; (4) *Eristalis tenax* L.; (5) *Eristalis brousi* Will.; (6) *Helophilus laetus* Loew.; (7) *Helophilus conostomus* Will.; (8) *Mesogramma marginata* Say.; (9) *Sphaerophoria cylindrica* Say.; (10) *Pyrophaena ocyni* Fabr.; (11) *Brachypalpus* sp.; (*b*) *Muscidae*: (12) *Lucilia cornicina* Fabr.; (13) *Lucilia caesar*; (*c*) *Oscinidae*: (14) *Chlorops versicolor* Loew.; (*d*) *Mycetophilidae*: (15) *Asyndulum coxale* Loew, one specimen, probably an acccidental visitor, never taken on any other flower. B. Coleoptera—(*a*) *Chrysomelidae*: (16) *Donacia rufa* Say.; (*b*) *Curculionidae*: *Listronotus appendiculatus* Boh. C. Hymentoptera—(*a*) *Apidae*: (18) *Bombus vagans* Sm., m; very rare; (*b*) *Andrenidae*: (19) *Halictus similis* Smith, f; (20) *Halictus* sp.; (21) *Halictus palustris* Rob., m; common. Also two additional diptera *Rhyncodexia rufipennis* Macq. and *Phorbia acra* Walk.

PONTEDERIA CORDATA. PICKEREL-WEED.

There are some seven or eight species of *Pontederia,* all of which are natives of America. It is interesting, remarks Darwin, as the only instance of an irregular flower, or of a monocotyledonous plant, that is trimorphous. Several heterostyled species were found by Fitz Muller growing very abundantly in Southern Brazil. Measurements of the pollen grains of all the forms were made by Darwin. The pollen grains of the North American species have been examined by W. H. Leggett. In both cases the size of the grains from the longer stamens was about twice the diameter of the grains from the shorter stamens, or eight times the mass.

The flowers are arranged spirally in a glandular-pubescent spike or spadix. A species of greenish-brown *Aphis* may sometimes be found upon the stout, smooth leaf-stalks and underside of the leaves. The upper lip of the two-lipped perianth is 3-lobed and the middle lobe, which is the largest, is marked by two yellow spots, which tell of the presence and guide to the exact location of the honey. The nectar is found at the base of the pistil on the upper side. The lower perianth-segments are much less firmly united and are readily separable. After blooming the flower coils upon itself, the fleshy base remaining persistent and enclosing the fruit.

This is one of the handsomest as well as commonest of river plants, producing thousands of spikes of light-purple flowers with blue anthers. The coloration and pleasant fragrance at once point to bees as the most important visitors. Most diptera are, moreover, excluded by the length of the tube. The flowers are sessile and the tube curves outward thus bringing the mouth nearer the horizontal and facilitating the movements of the guests.

Bees visit the flowers with surprising rapidity. I repeatedly timed *Bombus vagans* and the average was about 70 visits per minute. The larger *Bombus borealis* is slower, making about 60 visits per minute. Butterflies are comparatively rare and no coleoptera have been observed.

Visitors: A. Hymenoptera—(*a*) *Apidae*: (1) *Bombus vagans* Cr., m, abundant; (2) *Bombus borealis* Kirby, n, common; (*b*) *Andrenidae*: (3) *Halictus crassicornis* Kirby, (4) *Halictulus*

Americanus Ashm., m, collecting pollen; B. Lepidoptera—*Rhopalocera*: (5) *Argynnis cybele* Fabr.; (6) *Pieris rapae* Linn.; (7) *Colias philodice* Godt.; C. Diptera—(*a*) *Muscidae*: (8) *Pollenia rudis* Fabr.; (*b*) *Syrphidae*: (9) *Mesogramma marginata* Say.; (*c*) *Ephydridae*: (10) *Discocerina* sp.; (11) *Discocerina* sp., all four feeding on pollen.

July 21-August 10, Waldoboro, Maine.

In the determination of insects I am indebted to Prof. H. F. Wickham and by the courtesy of Dr. L. O. Howard to Messrs. Wm. A. Ashmead and D. W. Coquillett.

Shorter Articles.

Seed Production.

Some experiments on cross-fertilization recently led me to determine the average number, and the average weight of the seeds produced by different flowers of the same plant. From the results thus obtained mere curiosity prompted me to calculate the total number of seeds produced by individual plants. As I have seen no estimates of this character in print, and as the results may have some bearing on the subject of plant dissemination, I have thought it worth while to record them here. The figures are as follows:

Digitalis purpurea.

	Number of Seeds.	Average Wt. of Seeds. (*grams.*)
Average of six capsules from bottom of inflorescence	1581	.0000840
1 capsule from middle of inflorescence	1828	.0000761
1 capsule from middle of inflorescence	1679	.0000788
1 capsule from middle of inflorescence	2076	.0000831
1 capsule from top of inflorescence	1122	.0000888
1 capsule from top of inflorescence	1302	.0000872
1 capsule from top of inflorescence	1553	.0000830
Average of above	1592	.0000830

This plant (one of medium development only) bore 176 perfect capsules, which, by the above averages, should contain 280,192 seeds. A similar estimate for a plant of *Lychnis coronaria* showed 470 capsules and a total of 43,710 seeds; a two-year-old vine of *Cobaea scandens* showed 1,078 capsules and 20,494 seeds; and a well-grown vine of *Lathyrus odoratus* yielded 260 capsules and 1690 seeds.

In considering these figures we must, of course, take into account a large number of modifying circumstances, but it is somewhat surprising to learn that a single seed of *Digitalis purpurea* is capable, under reasonably favorable circumstances of producing more than a quarter million of its kind in a single season. Possibly some of the other readers of the *Bulletin* can obtain figures for other plants, even exceeding the ones here presented.

W. C. BLASDALE.

Berkeley, California.

Leaf Retardation in Podophyllum Peltatum.

Last winter, while determining some plants in the herbarium of my fellow-collector, Mr. J. A. Hood, we came upon an abnormal specimen, which aroused our interest, and during the past summer we have had this sport in mind with the result that four specimens were collected in stations 12 to 15 miles apart, all showing the following strange peculiarity: Instead of a flower nodding in the forks of two branches, as we commonly find in *Podophyllum peltatum*, it is on a long, naked scape, with or without a single leaf, only, by its side, giving it a very remarkable aspect.

In the first specimen noted the flower-stalk was about ten inches high, the bud large and in a tilted position. The stalk was thin, not over one-eighth of an inch thick, very like the short peduncle of an ordinary May-Apple, except for its extreme length. The leaf bud was found underground, in a good, healthy state, ready to force itself up to the sunlight. It was pale, but the veins were rich with juice.

A second specimen had the flower partly open, the sepals yet intact. We very carefully dug this up and found seven nodes on the rhizome, showing it to be at least seven years old. This we transplanted to our wild-flower garden and awaited developments. It never developed a leaf. The flower was to all appearances identical with the May-Apple blossom. The fruit, however, never became yellow and succulent, but remained a dark, glossy green until it withered; it was about one and a fourth inches long, on a scape eight inches high.

A third specimen developed fruit similar to the second specimen; the leaf made its appearance after the flower, but soon dwindled away, never coming to maturity. A fourth specimen was found in flower, with one perfect leaf, 5-parted, but small and dwarfed; much like specimen three, except that the leaf was perfect and long-stalked. The fact that this peculiarity has been observed two successive years makes us deem it worthy of mention.

Since the above was written, Mr. Hood has unearthed, in the Library of the University of Wisconsin, an article by Dr. Porter on variations of the Podophyllum, which it might be interesting to read in connection with this note.* Our specimen seems to be a remarkable case of retardation, as far as leaf is concerned, with corresponding acceleration on the part of the flower stalk. Forms 7 and 8, of Porter's drawings, are abundant in Racine and Kenosha counties of this State.

Still another variation was noted, which seems to be intermediate between numbers 6 and 7, of Porter's illustrations.

It would be interesting to learn if occurrences similar to those above noted, had been observed by other collectors. It certainly is a most peculiar form.

**Botanical Gazette*, 1876-79, vol. II. p. 17.

S. C. WADMOND.

Racine, Wis.

Abnormal Flowers of Verbesina.

The genus *Verbesina* is characterized by heads which are few or many flowered; rays pistillate few, or none, disc flowers hermaphrodite; scales of the involucre in two or more series, imbricated, erect; chaff concave, or embracing the flowers; achenes compressed, 2-awned. It is clearly evident that this genus is one of the more primitive ones of the order Compositae, because we find the ligulate flowers absent, or when present comparatively few in number; because we find the flowers less closely aggregated together with chaffy scales between, and because the pappus is present in the form of awns, or scales. The presence of chaff indicates that the crown beards are morphologically more primitive than others of our more common composite plants. The open arrangement of the heads points to a less consolidation; more space is left for the development of the individual flowers. This want of pressure between the several flowers composing the head and nutritive changes explains the origin of the abnormal, or teratological flowers now to be described.

The flowers in the bud are enclosed by the boat-shaped, chaffy scale, which is pubescent along the upper margin and slightly roughened along the mid-rib by the sharp-pointed, reflexed hairs. The broad, flat face of the pubescent achene is placed parallel to the side of the chaffy scale which enclosed it. Two sharp-pointed pappus scales are so placed that one of them projects from the open side of the chaffy scale. On the achene there are four prominent ridges, two of which are prolonged into the sharp-pointed pappus scales. The corolla is short tubular, the anthers reach to the top of the throat; the stigmas are pubescent on the outside. A cross section of the achene shows normally only one cell. It was found in studying the abnormalities displayed in a number of plants, that the capitula were normally developed, but externally the number of stigmatic lobes in certain of the flowers appeared augmented to 3, 4 and 5. In examining one of the flowers with a 3-lobed stigma, it was found that the stamens and petals were normal in number, as also the scale of the pappus, one of which was separated down to the base of the achene. The thought suggested itself that these scales might represent two bracts fused with the ovary. A further examination of a number of heads of this plant showed that more than three stigmatic lobes might be present in a flower. One flower was found that had six stigmatic lobes and nine (9) well-developed stamens and eight petals, the ovary being somewhat three-angled with three-awned scales surmounting it. The ovary was one-celled with three ovules. Another flower had seven petals, seven stamens, five stamens with indication of a sixth, the ovary, three-angled with three awns, one-celled with four ovules. Another head showed two flowers fused together; one flower was normal, the other consisted of seven petals, seven stamens and five styles.

In examining these teratological cases, the writer was struck by the partial reversion of a number of flowers to a more or less ancestral condition, for it is conceivable that the flowers of Compositae in the gynoecium are much reduced, as to the number of carpels which enter into the formation of the pistil.

JOHN W. HARSHBERGER.

University of Pennsylvania.

Stems Pierced by Rootstocks.

I think it is Emerson who says a person finds what he looks for. In the absence of leaves on the trees I have several times been surprised at the number of natural grafts to be found in a few hours.

One of the interesting things in connection with transplanting is the opportunity it affords for seeing what has been going on out of sight beneath the surface of the ground. Much remains to be learned in this line of study, as few people are giving the subject any attention, while during the growing season green foliage and beautiful flowers are everywhere in sight in myriads of eyes.

Several of our grasses, such as quick grass, June grass, Bermuda grass and red-top, produce large numbers of stout underground stems, known as rootstocks.

The tips are sharp and stouter than might be supposed. While digging potatoes I have several times come across tubers that had been pierced by rootstocks of June grass or quick grass. In one hill I once found two tubers thus threaded by grass. A gardener in 1884 brought me a bulb something like a small onion that had grown in a flower-pot, and through it was an underground stem of June grass. In 1888 one of my students found an herbaceous stem with June grass extending through it, and the same year another student brought me the lower portion of a lily pierced by a June grass rootstock, and this rootstock was itself pierced by another rootstock of the same kind of grass. The specimens above referred to are well preserved in the college herbarium, and are objects of considerable interest. Monstrosities of this character and of other kinds are well worth preserving.

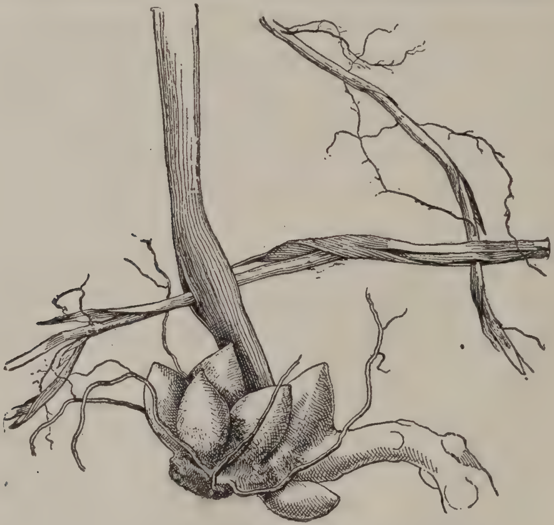

FIG. 12. LILY STEM PIERCED BY JUNE GRASS ROOTSTOCK.

W. J. BEAL.

Michigan Agricultural College.

(The following notes are from a correspondence bulletin of the Gray Memorial Botanical Chapter)—Editor.

Plant Vitality.

The vitality of plant life is sometimes remarkably illustrated. Two years ago I collected, on the upper slopes of Mt. Wilson, Pasadena, Calif., a specimen of the rare *Cotyledon Nevadensis*, a fleshy plant belonging to the Sedums, with a long root and a cluster of thick radical leaves. It was growing on rocks and was well fitted to resist conditions of lack of moisture, as is evident by its history.

I pressed it as dry as possible and put it in my herbarium, leaving one specimen unmounted and outside the covers on a shelf in my cabinet. It was tightly shut up and was in the dark. Lately I noticed that it had grown into an upright shoot nearly two inches high, with ten little leaves, showing a tinge of green. It has never had a drop of moisture except what it could absorb from the atmosphere. To reward it I have now placed it in the window to see what growth it will make in the light, but fancy that it has nearly exhausted the stock of nourishment stored in the dry stems and leaves.

CONSTANCE G. DU BOIS.

My specimen of the house-leek or live-for-ever (*Sedum telephium*), after being tightly pressed for several weeks, *with the inside of the stem* (or all except the bark) removed, until it was dry and crisp, was laid between dry sheets of mounting paper.

In a week (of rather dry weather) it had absorbed sufficient moisture from the air to make the leaves near the top fleshy again, and new shoots had started from the axils of the leaves. These young leaves were white in color from lack of light.

THEODORE G. WHITE.

This tenacity of life is well illustrated in the Resurrection Plant (*Selaginella lepidophylla*) that grows in California and New Mexico. When deprived of moisture it simply curls itself up into a ball and remains dormant until moisture is supplied, when it will again expand, become green and grow. I have kept one of these plants for months at a time.

IDA CLENDENIN.

News and Notes.

The Boston Mycological Club now numbers 400 members. A trained botanical student has been engaged to take charge of the herbarium. A bulletin issued by the club in July contains a useful synopsis of the families and genera of the fleshy fungi.

Mr. Edward Tatnall, the well-known botanist of Wilmington, Del., died May 31, aged 80 years.

Apropos of cactus vitality mentioned in the February *Bulletin*, E. W. Berry relates a more surprising instance in the case of the common prickly pear cactus of the Eastern States, which was gathered in 1889 and placed in a drawer. In 1891 it put forth a long green sprout, and in 1897 this sprout produced two perfect blossoms, after having been exposed to the air and light for two weeks.

The herbarium of the Shaw Gardens, St. Louis, Mo., contains 288,300 specimens, and the library, one of the finest on botanical subjects in America, embraces 31,013 books and pamphlets.

Prof. Anton Kerner Ritter von Marilaun, especially noted for his work on the insect fertilization of flowers and his natural history of plants is dead, at the age of 67 years.

The New England Botanical Club, recently organized, meets on the first Friday of each month at Harvard University. Dr. G. L. Goodale is President and E. L. Rand, 740 Exchange bldg., Boston, is Corresponding Secretary.

A College of Forestry has been started at Cornell University, with a liberal endowment of money and land. Dr. B. E. Fernow, chief of the Division of Forestry, U. S. Department of Agriculture, has been appointed director.

In a recent issue of Lloyd's excellent photogravures of American fungi, a photograph is shown of a specimen of *Polyporus Berkeleyi*, 2¼ feet across.

Dr. W. F. Ganong has discovered the interesting fact that about one-half of the seeds of the prickly pear cactus (*Opuntia vulgaris*) have more than one embryo. *Opuntia tortispina* is the only other species of cactus in which polyembryony is known.

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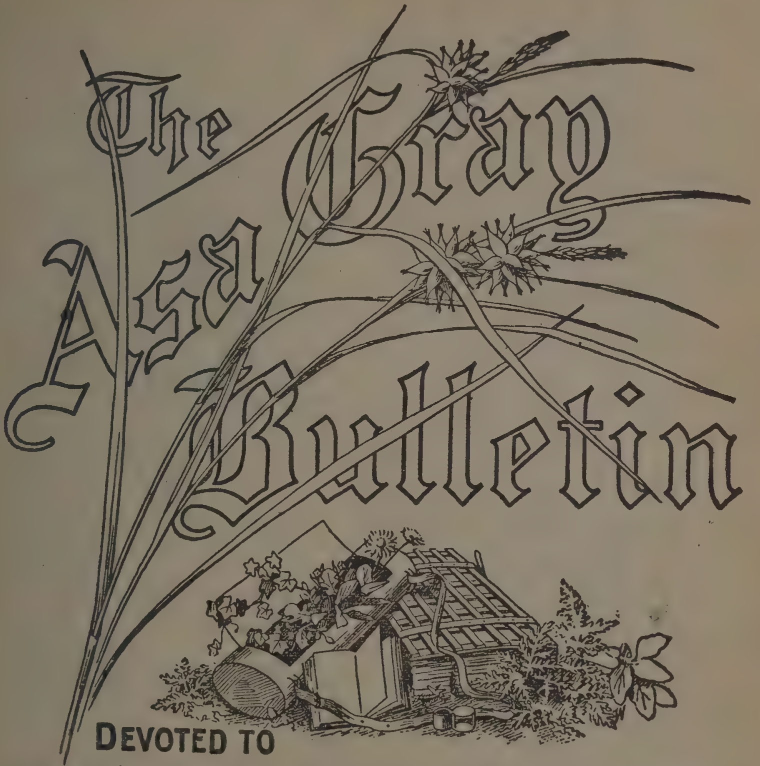

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PLANT LIFE IN FIELD, FOREST AND GARDEN.

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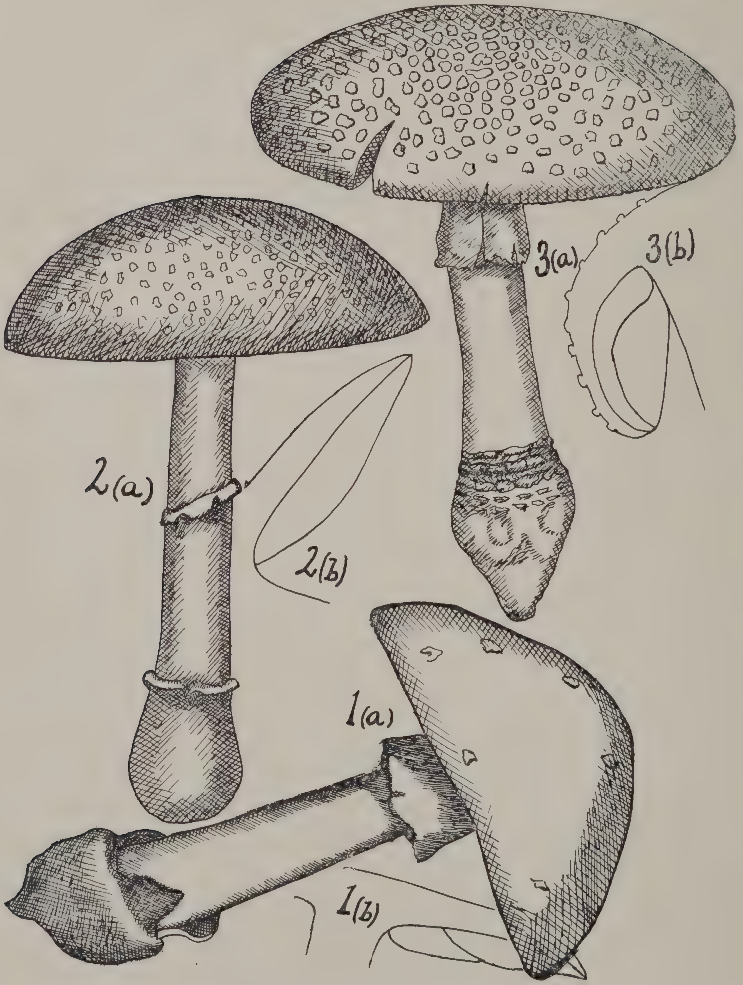

THREE POISONOUS AMANITAS.

1, Amanita phalloides; 2, A. pantherina; 3, A. muscaria; (a) mature plants; (b) sections of cap showing gills. (See p. 80.)

Asa Gray Bulletin.

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Studies in Plant Physiology—I.

The Nature and Work of Plants.

DR. D. T. MACDOUGAL.

The tints of a flower and the graceful curves of a twining vine excite admiration because they gratify our sense of beauty. These and other features of the vegetable world become of much greater interest when it is learned that the color of the rose, the lace-like fronds of the fern, the imposing trunk of a forest tree, the spines of a thistle, and the juicy sweetness of a berry are due alike to the action of the living substance or protoplasm of the plant. If our studies were extended we should learn that protoplasm has certain definite modes of action or is subject to certain rules, that the living matter of plants is very much like that of our own bodies, and that the protoplasm of both is governed by the same general laws.

The principles of the activity of the protoplasm of plants are briefly outlined in the following paragraphs, and the simple experiments described are designed to give a conception of some of the more important kinds of work performed by plants, and in some instances, measure the amount accomplished.

The plant is a machine, and it is composed of many more separate parts than a watch or a locomotive. The construction of a locomotive or a watch may be learned by tearing one to pieces or by building it up from its separate parts. After this has been done it is much easier to understand the running of the timepiece or the engine. The same is true of the plant machine. The composition of a plant may be found by separating into its parts or by finding what substances it uses in growth in building up its own body; it is to be noted that a living object has this power of taking up material and using it to increase the bulk of its body, or of replacing parts that are missing or destroyed, a thing beyond the power of the simple machine. The parts of a plant are so closely bound together that it is not possible to take it apart so neatly as we might an engine, and it uses so many substances for food that it is not easy to determine the exact importance or place of all of them. By using both the tearing down and building up processes a good idea may be obtained of its structure, however.

EXPERIMENT 1. Water, ash and charcoal in plants.—Place enough leaves or stems on the pan of a balance or spring scales to weigh exactly one-half of a pound. Now remove the material to a shallow dish or pan and place on a stove where it is warm enough to boil water, for two hours, or out in the hot sunshine for half a day. When the stems or leaves become brittle remove them from the dish and again weigh. The material is not so heavy as before. Pour on water from a measuring glass until the former weight is restored. How many ounces were necessary? The amount poured on was originally present in the plant and was driven off in the form of vapor during the heating and drying. It will be found that about three-fourths of the weight of the leaves consisted of water. The leaf becomes smaller in drying, as you may measure if you trace the outline of a fresh leaf upon a sheet of paper; then dry between two sheets of blotting paper to keep it flat. If the dried leaf is placed over the tracing it will be found to have shrunken in both length and breadth.

If the dried leaves are placed on the glowing coals or in the flame of a spirit lamp they blaze up at first, then burn with a steady glow, until nothing remains but a pinkish or grayish white powder. The part burned away has been obtained principally from the air, and is called the charcoal, while the fine powder remaining came from the soil, and is termed the ash. If the leaves and the charcoal and the ash were weighed on a delicate balance such as druggists and chemists use, it would be found that the charcoal and the ash together make up scarcely one-fourth of the weight of a plant, of which the ash forms but a small proportion. It is thus to be seen that the plant is a machine that is built of seventy to ninety parts of water, nine to twenty parts of charcoal, and one or two parts of ash or mineral substance.

The proportions of the different classes of substances entering into a plant vary from the above in many species. The greatest proportion of ash is found in the leaves, because the water starts from the soil carrying the ash elements and passes upward through the stem into the leaves, where it passes off in the form of vapor, leaving the minerals behind. In some instances the ash or mineral substance is deposited on the surface in a layer that can be seen on the living plant. This is the case with the scouring rush. In this plant a complete coat of silicon covers the surface, and the plant gives a distinctly rough feeling when handled. This sheath of silicon may be separated from the stem by the following method.

EXPERIMENT 2. Silicon on the scouring rush (Equisetum).—Cut two or three pieces a few inches in length from the stem of a scouring rush and place in a test tube or a glass dish. Cover with water containing one-fourth part of muriatic (hydrochloric) acid, and warm on the stove for a few hours. The delicate tissues will be broken up and destroyed, and the silicon sheath alone will remain.

Sometimes plants cause a coating to form on their bodies by their action on the water in which they grow. This is true of the "calcareous" algae, the Potamogetons (pondweeds), and many other species.

The soil always contains more or less water, and the mineral elements used by the plant are dissolved in this water. The waters of streams and ponds are in constant contact with the soil, and hence it contains the salts or mineral foods of the plant. Rain water, on the other hand, results from the condensation of vapor which has risen from the ocean, lakes or rivers, and contains no salts if caught in a clean vessel. It will be interesting to grow plants in rain and soil water.

EXPERIMENT 3. Water cultures with and without salts.—Fill a quart fruit jar with clean rain water or distilled water, and a second from a pond or stream. Put in each a freshly cut twig of the willow a foot in length, and place both in sunlight in a warm room. Keep the jars clean and replace with fresh water weekly. The twigs will soon start to growing, even if the experiment is performed in the winter time. Compare the twigs in three or four weeks. Have they grown alike? If a difference is shown in the number and size of the young leaves and roots, to what is it due? The next experiment may throw some additional light upon the problem.

EXPERIMENT 4. Ash or salts in the water of streams.—Boil a quart of rain water in a dish with a polished inner surface until it disappears. Examine the bottom of the dish. It has left nothing behind, and therefore contained no mineral food for the twig. All growth shown by the twig in rain water was made at the expense of such food already present in the plant. Now boil a quart of water from a pond or stream until it all passes off in vapor. Examine the bottom of the dish. A grey coating remains, consisting of the mineral elements which are taken up by the plant and form the ash when it is burned. This is similar to the deposit formed on the inside of tea-kettles when "hard" water is boiled in them. The ashes of a wood fire are, of course, the same as that obtained in Experiment 1. If it were possible to make a complete analysis of a plant, it would be found that the ash contains nitrogen, sulphur, phosphorus, magnesium, calcium, potassium, sodium, iron, and chlorine, which are chiefly obtained from the water in the soil, while the elements in the charcoal—carbon, hydrogen and oxygen—are obtained partly from the soil water and partly from the air.

A perfect food for the willow twigs or for almost any common plant may be made by adding to each quart of water put in the culture jars 10 grains each of common salt, plaster of Paris, Epsom salts, calcium phosphate, and a few drops of iron chloride.

Before the study of the manner in which the plant gains food from the air can be taken up it will be necessary to learn something of the way in which the plant machine operates, a subject to be taken up in the following paragraphs.

Half Hours With Lichens—II.

T. A. WILLIAMS.

The lichens collected and properly preserved, the true students are naturally desirous of studying them in a thorough and systematic manner. There is little real satisfaction in simply collecting material and sending it to a specialist for determination without studying it oneself. No matter if one does expect to send the specimens to the specialist, he should at least study them sufficiently to be able to appreciate the notes and remarks of the person making the critical determinations. A specimen is always more valuable and will receive more careful consideration at the hands of the lichenologist when it is accompanied by neatly made notes and drawings, showing that the sender is really trying to gain some substantial knowledge of the plants for himself. When one sends material in this manner he may be sure that it will always be well received and the specialist will always be glad to get more of such material.

Aids to the Proper Study of Lichens.

One of the prime requisites for the proper study of these plants is a compound microscope. It is not often in ordinary work that one will need a magnification greater than 750, or that which is given by a one-inch eyepiece and a $\frac{1}{8}$ objective. Occasionally a greater magnifying power will be found desirable or even necessary. In general, powers of from 500 to 750 will be needed in studying the structure of the thallus and fruit. Often the hand lens is not sufficient for the proper study of their external features. In such cases the $\frac{3}{4}$ objective with top illumination will render good service. The microscope should be supplied with an eyepiece micrometer for which the values have been carefully determined. This is necessary for the accurate measurement of spores, gonidia and other organs. A good camera lucida will be useful in making sketches of the parts studied, but it is not a necessity. Knowing the value of the spaces on the eyepiece micrometer, one can, with the aid of a finely graduated pocket rule sketch the spores and other organs according to any desired scale. The metric system will be most satisfactory for use in making these measurements.

For ordinary purposes mounts may be made directly in water, but in certain instances solutions of iodine and potassium or other substances may be needed to bring out certain features of the lichen structure. The two most useful re-agents are a 5 or 10 per cent solution of potassium hydroxide and the iodine solution, perhaps best made according to the formula, "iodine, 1 grain; iodide of potassium, 3 grains; pure water, 1 ounce." In studying the details of the lichen structure it is often advisable to make use of some such staining fluid as borax-carmine to bring out the parts well.

For most purposes free-hand sections of the thallus and fruit made with a sharp scalpel or razor will be found satisfactory, but when extended studies of structural details are to be made, imbedding and sectioning with a microtome will be necessary. Very good directions for doing this work will be found in the June and July numbers of the current volume of the *Journal of Applied Microscopy.* Often the necessary fruit-characters may be made out from mounts made by crushing a fruit (if small) or a portion of one (if large) on the slide in a drop of water with the point of the scalpel and then tapping the cover glass lightly with a pencil or the handle of the scalpel to spread out the material and free some of the spores.

Next to the microscope and its accessories the student needs good literature; and it is here that the amateur meets some of his greatest difficulties. Much of the literature dealing with our North American species is fragmentary and printed in foreign languages. The works of Tuckerman, our greatest American lichenologist, are incomplete, owing to his untimely death. His writings, although they must ever be regarded as the foundation of North American lichenology, are not always satisfactory to the amateur on account of the involved style in which they are written. Nevertheless no one should attempt the systematic study of our species without providing himself with a "Tuckerman." Among other lichenologists of later times, whose works will need to be referred to, are Nylander, Mueller, Willey, Wainio, Stizenberger and the younger Fries. Of the earlier men Acharius, the elder Fries and Schaerer will be most useful.

The first book that the beginner should read is Willey's "Introduction to the study of Lichens." The instructions given in this little work are so simple and clear and withal so thorough—coming from the pen of a lifelong student of these lowly plants and a most accurate observer—that it is a most useful work. It is to be regretted that the only edition published was so soon exhausted. The recent book of Dr. Schneider will also be found useful, but is much more voluminous. Of the more purely systematic works one needs at least Tuckerman's "Genera" and "Synopsis," Nylander's Lichenographia Scandinavica, and the Lichenographia Universalis of Acharius; and it would be well to add to these, if possible, Willey's "Arthonia" and Nylander's "Pyrenocarpeorum" since neither of these groups were reached by Tuckerman in his "Synopsis." At the end of this article is appended a small list of some of the more important systematic works containing descriptions of North American species.

A very valuable aid in the determination of lichens is an authentic set of dried specimens, such as may be found in the various sets of Exsiccati, issued in this country and in Europe. One can often get better results from a few moments spent in comparing material with such specimens than from hours of poring over descriptions that are by no means always intelligible.

A Short List of Works Useful in the Study of North American Lichens.

Acharius—Lichenographia Universalis, 1810; Synopsis Lichenum, 1814.

Fries, E.—Lichenographia Europaea Reformota, 1831.

Fries, Th. M.—Lichenes Arctoi, 1860; Genera Heterolichenum Europae, 1861; Lichenographia Scandinavica, 1874.

Koerber—Systema Lichenum, 1855; Parerga, 1865.

Nylander—Expositio Pyrenocarpeorum, 1858; Lichenographia Scandinavica and Sup., 1861-66; Prodr. Flora Novo-Gra-

natensis, Ed. 2, 1864; En. Lich. Freti Behringii, 1888; Les Lich. Paris, 1896; Synopsis Method. Lichenum, 1858-1888.

Schraerer—Lich. Helvet. Spicilegium, 1823-36; En. Crit. Lichen. Europaeorum, 1850.

Tuckerman—Genera Lichenum, 1872; Synopsis of North Amer. Lichens, 1883-88; Lichens of California, 1866; Lichens of New England, 1848.

Wainio—Adj. Lich. Lapp. et Fenn. 1881-83; Lichens du Bresil, 1890; Monographia Cladoniarium, 1887-98.

Willey—An Introduction to the Study of Lichens, 1887; Synopsis of the Genus Arthonia, 1890; Lichens of New Bedford, 1892.

Common Edible and Poisonous Amanitas.

E. M. WILLIAMS.

In a previous article on Lepiotas the statement was made that one of the principal differences between the Amanitas and Lepiotas was that the former had a cup-like base or volva, which the latter did not have. This statement, while true, strictly speaking, should have been modified by saying that there were a number of apparent exceptions. In some of the Amanitas no volva is to be seen in mature specimens, and often close searching is required to find traces of it. Strangely enough, the most likely place in which to look for these traces is on top of the cap. To understand how this can be, one must look to the method of growth and development of the fungus.

When the Amanita is young it is enveloped in a membrane, which is entire and covers every part of it. As the cap grows the membrane bursts in some place to let the rapidly expanding cap have room. The place where this rupture occurs varies in the different species, across the top in some, around the edge of the cap in others, and near the base in others. When it breaks across the top, the volva is unusually large, loose and irregular, and the cap with few or no scales adhering to it. (Pl. I, fig. 1.) When around the edge the cup is generally medium-sized, and the part that is carried up is broken by the expansion of the cap into patches which recede from one another as the growth goes on. Unless these are wasted away they are usually to be found more or less abundant and scattered over the top, varying in thickness according to the size of the cap and the nature of the original membrane. (Fig. 13, No. 5.) When most of the membrane is carried up the patches are generally more numerous and thicker, but often it requires careful searching to find traces of the presence of a volva on the stem, unless the cap is immature. (Pl. I, fig. 3.)

Besides the cup, the Amanita has also a veil which covers the gills, and is pendant on the stem or from the edge of the cap at maturity. Like the cup this is sometimes hard to find, and in Amanitopsis (recognized as a separate genus by some, a subgenus of Amanita by others) it is difficult to find even a trace.

The Amanitas are generally fleshy, and many species are large and showy. They are common throughout the summer, but most abundant in midsummer, especially in warm, moist weather. It is not definitely known how many representatives occur in this vicinity or the names and properties of each. There are at least three of those classed as edible and three poisonous ones common about Washington, besides a number whose qualities are not so well known. These are figured herein, Pl. I representing poisonous species and Fig. 13, edible ones.

Of the poisonous species, *Amanita phalloides* with its white form, often called *verna* (Pl. I), is by far the most deadly, no known antidote for the poison contained in it having ever been found. It is common throughout the summer in moist, wooded places under both evergreen and deciduous trees. It has a large cup, a broad pendant-veil, and generally but few, sometimes no, patches on the upper surface of the slightly viscid cap. The stipe is smooth and white, the gills white, the margin even and the cap varying in color from purest white to pale green or yellowish white. It is said to have a pleasant flavor, but is so poisonous that putting it for a short time in the same basket with edible forms or even handling it in a close room has been known to cause quite serious illness. The next in order as a mischief-maker is *Amanita muscaria* (Pl. I). This is the Fly Agaric, and is not so bad as the preceding, since there is an antidote for the poison, which, if taken in time, lessens the danger. Still it is bad enough to have been the cause of many deaths. This is one of the Amanitas in which there is little of the cup to be found. The base is bulbous, and with only a number of rows of scales representing the membrane. Abundant evidence is to be found on the upper surface, however, in the many and quite persistent warts. It has a broad annulus, a pure white stem, a top with striate margin and is generally brightly colored, yellow or deep orange, but is occasionally almost or pure white. The gills are white and the fungus large and attractive looking, but its charac-

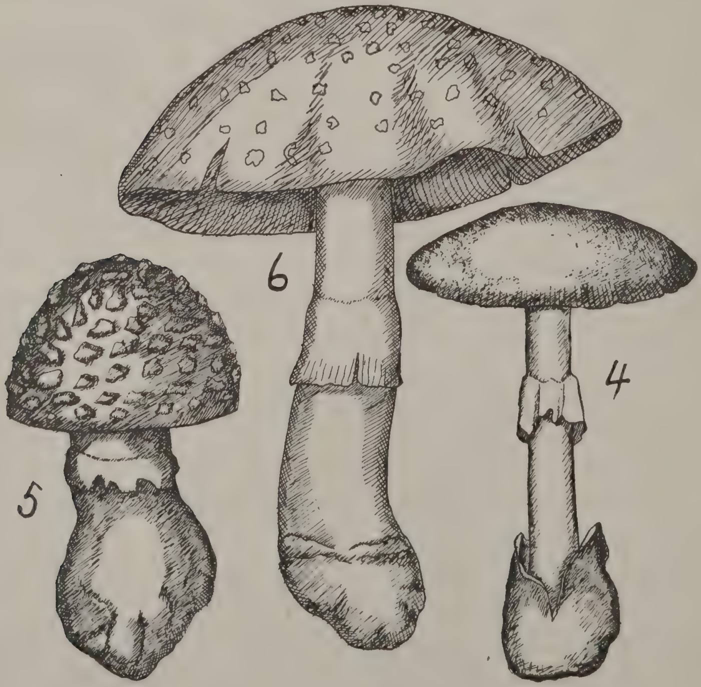

FIG. 13. THREE EDIBLE AMANITAS.
4, Amanita Caesarea; 5, A. strobiliformis; 6, A. rubescens.

ters are so pronounced that it seems hardly possible that one could mistake it for any edible species. It often attains a height of from 8 to 12 inches and a diameter of the cap of from 4 to 6 inches.

Amanita pantherina (Pl. I) is also said to be poisonous, but is not so well known. While it is common in its season (midsummer) it is by no means as abundant as the other two species. It is whitish, with generally a darker, grayish or brown center, and with a large number of small patches adhering to the surface. The top is somewhat viscid, the margin striate, the gills and stem white. The cup is evident, but not so prominent as in *phalloides.* It does not present a tempting appearance, and it is hard to imagine one wishing to eat it.

Among those classed as edible, the following are more or less common here:

The most brilliantly colored, and by far the most attractive appearing is *Amanita Caesarea* (fig. 13, No. 4). It is konwn as Caesar's Mushroom. It is generally of a bright orange color, nearly uniform or slightly darker at the center. The margin is even and the stem and gills yellow. The rather broad veil is yellowish and the large, loose cup is usually white. This fungus is so brightly colored and so beautiful that it always attracts attention. It is said to be of the finest flavor. Unfortunately, there is another brightly colored yellow Amanita--still more abundant and occurring at the same time and in the same locations—that is supposed to be poisonous; this is *Amanita Frostii.* It is more yellow than orange, has a striate margin and white stem and gills. It resembles *Caesarea* so closely that it takes careful watching to separate the two, and until the innocence of the suspected one is proven beyond a doubt, both should be avoided by the prudent.

Amanita strobiliformis (fig. 13, No. 5) is a beautiful fungus, and for a limited season is quite abundant here. It is one of those in which neither cup nor veil is very much in evidence, though traces of the cup are left in fragments at the base, and in numerous upright tufts on the cap, and threads and patches of the veil often hang from the margin. It is pure white and very beautiful, but bears such a strong resemblance to pure white forms of *muscaria* that it would take courage born of strong conviction for one to attempt to eat it.

Amanita rubescens (fig. 13, No. 6) is perhaps the safest one to eat, if one must eat Amanitas. In this locality it is by far the most abundant, though it does not remain long. There are little or no signs of the enveloping membrane at the base, though large, loose patches may generally be found scattered over the top. The veil is large, often ragged, but generally attached in some manner to the stem, which is large, smooth and usually bulbous. The entire plant varies in color from a pinkish white to quite a deep shade of dull red, the red generally appearing only in wounded and bruised places on the cap, gills and stem. It has not a very appetizing appearance, but is abundant, generally growing in rings or rows, of large size, and hundreds in a very small area. It is rather easy to distinguish from the others, though some forms of *pantherina* are said to closely resemble *rubescens*. It is highly prized by many, and easiest of all to obtain.

He who eats Amanitas is running a risk that is hardly worth taking for any delicacy, however rare, and when so many less dangerous things are to be had, it would seem the part of wisdom to leave them to the larvae which seem to thrive on such diet.

Shorter Articles.

The Torrey Pine.

The rare Torrey pine or Soledad pine, *Pinus Torreyana*, grows abundantly at Del Mar, San Diego County, California, and, I believe, nowhere else in the world. This adds interest to its picturesque appearance. It is a beautiful tree, with the air of venerable associations, being the survivor of prehistoric forests.

The region about Del Mar is unique in natural scenery. On the one side lies the blue Pacific washing a wide sandy beach at the foot of a precipitous bluff, while on the other the ground rises steeply to a height of 500 feet or so, broken everywhere by narrow water-washed canyons and gullies carved from the rock and earth which in fantastic forms of turret and pinnacle mark the eddies of an ancient ocean. On top of the highest of these hills sea shells lie loosely intermingled with earth and pebbles. These shells are identical in species with those now found on the beach at Del Mar.

It can not be so many thousand years since the elevation of the land raised the former ocean beach to its present height. Whether the seeds of the Torrey pine were brought by the currents of this prehistoric ocean, or whether the newly made land had been an early forest submerged before it was elevated, and these seeds were preserved through an earlier deluge, I am not well informed enough to know.

The needles are five in a sheath and from 9 to 10 inches long. The cones are large and heavy, with upward projecting points. They are full of edible nuts, called in California *pinones*, beloved of boys and squirrels. The large tufts of scattered foliage give this tree the appearance of the conventional pine of Japanese decoration. Its ancestors may have come from the Orient. Who knows?

CONSTANCE G. DuBOIS.

[This pine has the most restricted range of any in the United States. All told, there are but a few hundred trees growing along the Pacific coast at the mouth of the Soledad River, Southern California, for a distance of about eight miles, and extending inland for a mile and a half; also a few on the island of Santa Rosa, off the coast. It was discovered by Dr. C. C. Parry, in 1850, who named it after the celebrated American botanist, Dr. John Torrey.—ED.]

A Rare Lichen.

In September last Mr. David Griffiths made a trip to the Hot Springs in the upper Lo Lo region in the Bitter Root Mountains, and collected fruiting specimens of *Hydrothyria venosa* Russell in considerable quantity in a small stream near the Granite Hot Springs. The find is interesting since it adds a third region for this species, which is the sole representative of the genus, which is an American one. It was first found in the White Mountains, and has since occurred in several localities in that region, being reported from Vermont, New Hampshire and Connecticut. Later it was found on the Pacific slope at Mariposa, California.

T. A. WILLIAMS.

Dwarfed Plants.

Observations that throw light on vexed questions are always welcomed. This applies to the note on stunted forms of Cruciferae, published in the *Bulletin*, by E. W. Berry, Vol.V, page 89. The question whether seeds will remain alive in the ground for years until conditions are favorable and then germinate is still as far from settlement as ever. We no longer give credence to the stories of mummy wheat germinating, but many cases are cited where a species not observed before in certain localities becomes more or less common after a field has been dug over. This would sometimes mean that the seed had been buried in the ground for years, awaiting favorable conditions.

Not a few of our common plants often produce stunted forms which are easily overlooked. These forms are produced when conditions are unfavorable, and may be repeated, perhaps, for a number of years, each year a few inconspicuous plants appearing until a time comes when they can grow normally. If this hypothesis is correct it may explain a number of cases of supposed longevity of seeds. We have found a plant of *Plantago aristata* but one inch high from the tip of the root to the top of the stem; it produced one perfect seed. A plant of morning glory, *Ipomoea purpurea*, was found which measured only two inches from the ground to the top of the flower; it had two perfect leaves. A plant of *Diodia teres* an inch high with mature fruit was found in some clayey ground.

A. J. PIETERS.

Editorial.

A New Departure.

Frequent inquiries come to us to furnish information on the edible or poisonous nature of various fleshy fungi. People throughout the country are becoming greatly interested in "mushrooms" and "toadstools," an interest increased by the rather frequent cases reported in the newspapers of fatalities resulting from the eating of poisonous species by persons unable to distinguish the good from the bad.

Various thriving mycological clubs in some of our larger cities attest the growing importance of this subject. No botanical magazine in America has given so much attention during the past year to fleshy fungi as the *Asa Gray Bulletin*, but at the request of numerous friends we shall devote more space than ever to this matter in the future. We have arranged to publish in each issue a popular article on some group of mushrooms, dwelling especially upon those supposed to be edible or poisonous. These papers will be illustrated with original drawings and written by specialists. In this number Mrs. Williams treats of the Amanitas. At the present time there is no complete American manual of fleshy fungi. By subscribing for the *Bulletin* and preserving all the numbers, a good handbook of this group of plants will be secured in time at a small cost. The Washington Mycological Club has adopted the *Bulletin* as its official organ, and we are arranging to have similar clubs do the same.

Other features of plant life will not be neglected. In this number Dr. MacDougal, Professor of Plant Physiology at the University of Minnesota, begins a series of elementary articles on the functions of plants, which will be of great benefit to teachers and students, including under the latter term those who study by themselves. It is this class that we desire especially to help. We are endeavoring to make the *Bulletin* a *live* journal, about *live* plants (mostly), for *live* people. It takes money and *grit* to do this in view of the competition to be met. We will furnish the latter if you will contribute your small share of the former.

More subscriptions will enable us to give our readers even more than we do at present for the money. Subscribe at once and show the *Bulletin* to your friends. You will also want a complete set of the present volume, of which only a few are left. The low price and the fact that we are covering fields but little worked by other journals, should warrant any one in taking the *Bulletin* in addition to any other botanical magazine which may be desired.

News and Notes.

The fiftieth meeting of the American Association for the Advancement of Science, held at Boston in August, was a success in every way. About sixty-five or seventy botanical papers were presented, an almost unparalleled number. The local botanists of the vicinity were untiring in their attention to visiting botanists. Dr. Farlow's address before Section G, on "The Conception of Species as modified by Recent Investigations among the Lower Fungi" was especially fine. It is published in full in the *American Naturalist* for September.

During the present season botanists of the Eastern United States have been much interested in the genus *Antennaria*, the result being the splitting up of *A. plantaginifolia* into several species and varieties. Mr. M. L. Fernald, whose article in the December *Bulletin* should be read in this connection, has recently published in the proceedings of the Boston Society of Natural History, a paper upon this subject. In this paper six species and seven varieties, all hitherto known as *Antennaria plantaginifolia* Hook., are described. Prof. Greene and Mr. Fernald are principally responsible for the careful study of these *Antennarias*, but they by no means agree in their ideas concerning the various species.

The subject of plant distribution is becoming a popular study among American botanists. A recent bulletin on the weeds of Kansas, by A. S. Hitchcock and G. L. Clothier, prints small maps, showing the distribution by counties of the principal weeds of the State, 209 in all. It also gives maps illustrating the distribution of 80 of them throughout the United States.

The family *Onagraceae* is treated in a similar manner by Professor Hitchcock in *Le Monde des Plantes* for June-July. Plant ecological studies have until recently been neglected in this country, owing to want of sufficient data upon which to base conclusions.

In this line of work every reader of the *Bulletin* could render substantial service by preparing a complete list of the plants of his county or township. Such a list should include notes as to frequency, and, if a weed, on the extent of its damage. Periods of blossoming, habit, abundance in wet or dry seasons, causes of increase or decrease in number of individuals of a species from season to season are further topics which should be treated in all local floras.

Few species of mosses, either in Europe or America, are credited with an altitude higher than 8,000-10,000 feet. In this connection it is interesting to note that Prof. J. M. Holzinger has collected over twenty-five species on Pikes Peak, at a height of between 12,502 and 14,147 feet.

A new, and in some respects remarkable ground-nut, *Apios Priceana*, from Kentucky, the only member of the genus, besides *tuberosa*, known in America, was described by Dr. Robinson in the June *Botanical Gazette*. It was named from its discoverer, Miss Sadie F. Price, the well-known local botanist of Bowling Green, Kentucky. Miss Price offers to send a specimen to any reader of the *Bulletin* who will remit 10 cents for postage and wrapping.

Mr. V. K. Chesnut, of the U. S. Department of Agriculture, was recently called to Trenton, N. J., to investigate the deaths of three members of one family, and the serious illness of four other persons of the same family from suspected mushroom poisoning. He found *Amanita phalloides*—well named the "Death Cup"—to be the cause of all the trouble.

Recent Literature.

The August number of the *Ladies Home Journal* contains an article entitled, "How to identify and cook twelve edible mushrooms," by a well known writer on cooking. In this otherwise excellent paper (barring a few typographical errors in the scientific names) the impossible is attempted of endeavoring to "impart exact knowledge to the laity regarding edible mushrooms," in an article of three columns with no illustrations, and a considerable of the space devoted to cooking recipes.

That such an article will find its way to so great a number of homes is to be regretted. When an amateur is to determine a genus of Hymenomycetes by "knocking the gills with the finger-nail" he is undertaking a large contract, and for scientific accuracy might as well go back to the old "silver spoon test" and be done with it.

E. M. W.

Minnesota Botanical Studies, Bulletin No. 9, was completed with part XII, issued March 7, 1888. With the index this makes a volume of 1,081 pp. and 81 plates, comprising, we think, the most extensive publication on botany in serial form of any American university. All phases of botany are represented in this volume, from bibliography and plant lists to ecology and physiology. While the work is necessarily somewhat uneven, including as it does the investigations of undergraduates as well as those of postgraduates and professors, it is on the whole very commendable, and Professor Conway MacMillan is to be congratulated for his energy and success in the inauguration and publication of these "Studies."

Under date of June 15, part I, second series of the above studies was published. It contains, among other things, articles on Minnesota lichens, algae and mosses, the latter by Prof. Holzinger.

The following interesting bulletins relating to botany have recently appeared from the U. S. Department of Agriculture:

Principal Poisonous Plants of the U. S., by V. K. Chesnut.

Some Edible and Poisonous Fungi, by Dr. W. G. Farlow.

Report on Grasses and Forage Plants of the Eastern Rocky Mountain Region, by T. A. Williams, and a revision of the North American species of *Calamagrostis*, by T. H. Kearney, Jr.

C. G. Lloyd, Cincinnati, O., has prepared a useful pamphlet entitled, "*A Compilation of the Volvae of the United States*," consisting of 22 pp., with 9 excellent half-tone illustrations from photographs of typical species. Keys and descriptions of all the American species are given. With the aid of this little manual one should have no trouble in identifying any of the Amanitas and other species belonging to this group. It is accompanied by the third report of the Lloyd Mycological Museum.

G. H. H.

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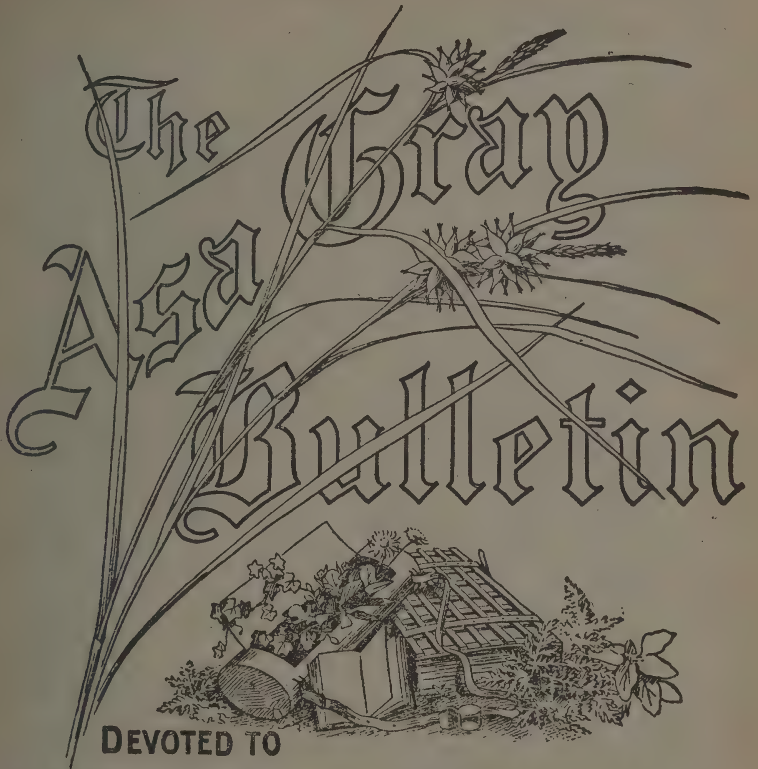

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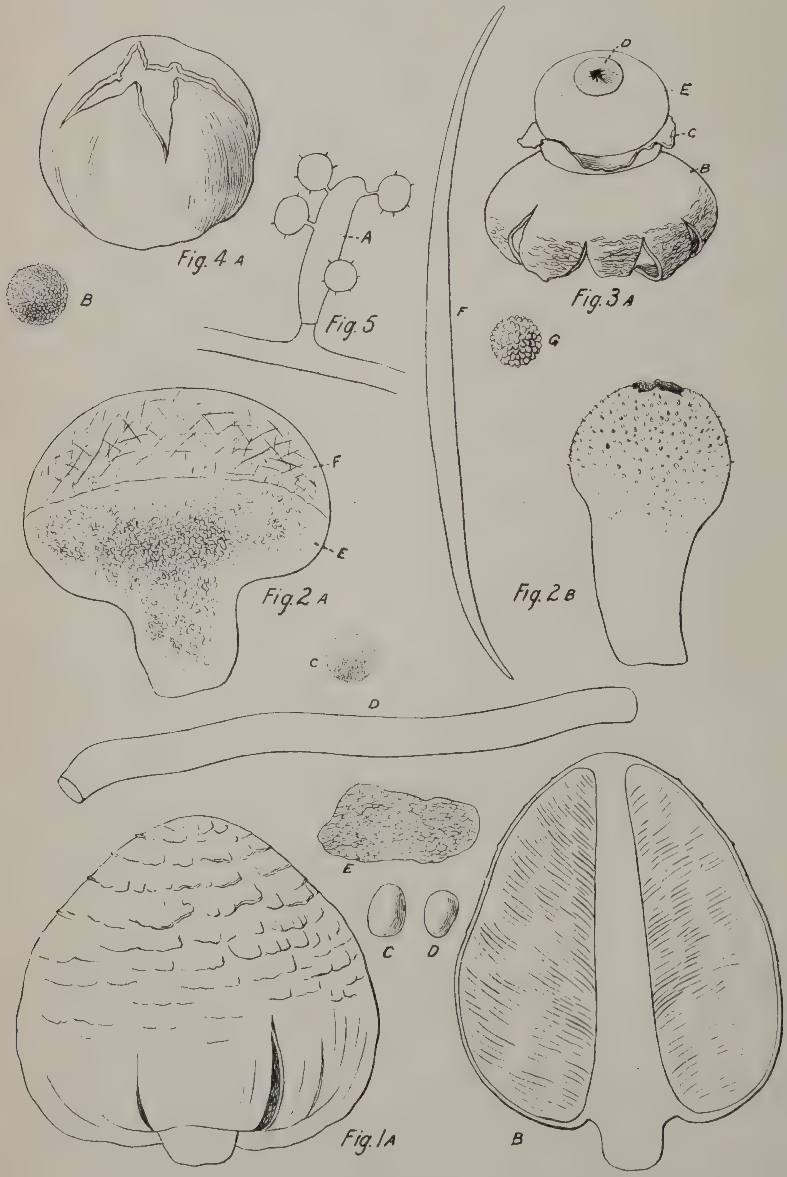

PUFFBALLS.

Asa Gray Bulletin.

Vol. VI. No. 6. DECEMBER, 1898. Whole No. 28.

Our Puffballs—I.

C. L. SHEAR.

Perhaps some of our readers in their autumnal rambles through field or wood have carelessly or unconsciously trod upon one of these unobtrusive plants, and had their attention attracted by the small cloud of brown dust which arose. This thoughtless act instead of being an injury to the plant was really a kindness, as it helped it to perform more quickly and perhaps more successfully one of its most important functions—the distribution of its spores which are intended to reproduce and perpetuate the species.

In their mature condition some of these plants are not very attractive, presenting to the casual glance only a yellowish or purplish brown mass of dust; but there are many others which, especially in their younger stages, are very pleasing in appearance, and all of them present in their structure and life history most interesting phases of plant life. Perhaps their attractiveness to the eye alone or their economic importance, so far as our present utilization of them is concerned, would not be sufficient to allure many to their study; but for those who would know more of nature's secrets and of her great ingenuity in devising ways and means of adapting things to her ends, there are many interesting things to be learned, and one carefully beginning their study in an interrogative state of mind will surely find many interesting questions arising.

Some of the puffballs have been utilized as food, and the giant puffball (*Lycoperdon bovista L.*) furnishes no mean amount when growing to the dimensions given by one of our early mycologists. He says he has found specimens 3 feet in diameter. Specimens weighing from 8 to 15 pounds are not rare, and if selected when young, cut in thin pieces, and fried, they make an excellent dish. Many of the smaller ones are also excellent for food, and none are known to be poisonous. For cooking purposes they should be collected while the interior is pure white and free from insect larvae. Some of our common species have also found a place in the materia medica of our country grandmothers as a remedy for bleeding, especially bleeding from the nose, the mature spores being inhaled in quantity.

We shall use the term puffball here to include all the members of the family *Lycoperdaceae.* The Lycoperdaceae are a family of the Gasteromyceteae. This last sesquipedalian term, which no doubt is rather forbidding to the beginner, has in its meaning a summary characterization of the plants which it includes. This, we are sorry to say, is more than can be affirmed of all botanical names, though the majority are intended to be descriptive of the plants to which they refer. The word referred to is composed of two Greek words which might be somewhat literally translated, "stomach fungi," the members of the group producing their spores in cavities in the interior of the fungus.

The Gasteromyceteae belong to a class of the vegetable kingdom known as the Basidiomycetes, another rather uninviting name to the novice. It means fungi bearing basidia. These are usually oblong or club shaped bodies upon which the spores are produced (fig. 5, A). They can only be seen by careful sectioning and the use of the compound microscope.

The life history, or course of development from spore to fruit, has been successfully followed in few or none of the puffballs, as the name is here used; and those who have a desire to add to the sum of human knowledge will here find a large field for activity, though, of course, there are difficulties to be surmounted. One of the great obstacles met in the work thus far has been the germination of the spores, most attempts in this direction thus far having been unsuccessful. A few species from some of the other families of the Gasteromyceteae have, however, been quite successfully followed during their various stages of development.

The *Lycoperdaceae* are fungi growing on the ground or rotten wood, or rarely beneath the surface of the soil. They are usually globose or pear-shaped in form, and may or may not be furnished with a short stem-like base. They are surrounded by an outer covering called the *peridium*, sometimes consisting of two layers and varying in texture from membranaceous to leathery, as shown in the figures.

Fig. 2, A, shows the membranaceous peridium, and Fig. 4, A, represents a leathery form. Fig. 3, B and E, shows the two layers of peridium called outer and inner peridium. When mature the peridium ruptures, usually near the apex, forming a regular opening (Fig. 3, D) or an irregular opening (Fig. 4, A) for the escape of the spores. Inside the peridium is the *gleba*, which, when the plant is mature, consists mostly of a loose mass of spores and fine filaments. The spores are minute, usually spherical bodies, either smooth or warty and colorless, or more frequently some shade of yellow, brown, or purple. They are borne on basidia (Fig. 5, A), but becoming free before maturity, they can only be found attached by careful sectioning of young plants.

In the systematic arrangement of these plants Dr. J. B. De Toni has been followed. It will be evident to one who has given much study to the subject that this arrangement does violence to the natural relationships of these organisms, but in the present condition of our knowledge a satisfactory arrangement is scarcely possible, and were it possible, this is not the place to attempt it.

This family is divided into four subfamilies, as follows: *Podaxineae*, *Diplodermeae*, *Lycoperdeae* and *Sclerodermeae*.

Podaxineae. The chief and most conspicuous character is that of the columella or stipe, a central column passing through the peridium as seen in *Secotium warnei* Pk., (Fig. 1, B) a member of this subfamily, which is found in most of the Northern States east of the Rocky Mountains, especially in Kansas, Nebraska and Iowa. The gleba surrounds this column. The plants of this group are very interesting, some of them suggesting possible relationships with the volvate agarics. A careful study of their development would no doubt throw much light on the question of their derivation and relationship. The name of this subfamily is taken from that of one of its principal genera, *Podaxon*, the term coming from two Greek words meaning foot and axis and referring to the prolongation of the foot or stem through the axis of the peridium, as shown in the figure of *Secotium.*

Diplodermeae. The name is descriptive of one of the principal characters of this subfamily. The peridium, which is more or less thin, consists of two distinct layers called the outer and the inner peridium (see Fig. 3, B and E, showing the two layers in *Geaster triplex* Jungh., a member of this group). The outer one is sometimes, however, not very persistent and soon disappears. The gleba is loose and floccose when mature, and the capillitium, which consits of thread-like filaments arising from the inner surface of the inner peridium, is mingled with the spores (Fig. 3, F), giving it a more or less fluffy appearance. Some of the genera, as *Tylostoma*, have a stipe or stem sometimes two or three inches long.

Lycoperdeae. In this subfamily the peridium is thin membranaceous and usually sessile in our genera, *i. e.*, seated upon the ground without any stem-like base, and with or without an outer coat (cortex). There is frequently present a sterile portion at the base of the peridium which is more compact than the gleba, and is sometimes called the subgleba. This shows nicely in *Lycoperdon gemmatum* Batsch (Fig. 2, E). The capillitium (Fig. 2, F) is loose and floccose. The name is taken from the name of one of the principal genera, *Lycoperdon*, one of the commonest species of this genus being represented in the plate (fig. 2, A and B).

Sclerodermeae. This takes its name from *Scleroderma*, one of its chief genera. The word is descriptive of one of the characters of the group, it being taken from two Greek words meaning thick skin, and refers to the peridium, which is thick and leathery; while in the other subfamilies it is usually thin and membranous. The gleba in this has a cellular appearance, as may be seen by cutting an immature *Scleroderma*. In the Lycoperdeae this cellular structure is wanting. Fig. 4, A shows *Scleroderma geaster* Fr., a member of this subfamily.

In following papers it is proposed to take up in order the United States species of puffballs, attempting to give brief and simple characterizations which may enable the beginner to become acquainted with this interesting part of our flora. If one studies plants for the sake of the name only, there is little to be gained, but the finding of the name is indispensable as a step toward any higher end. Descriptive botany is a sort of necessary evil. We must have names, and we must know them before we can communicate intelligently to others our observations and investigations. It is as necessary for us to know the names of the plants we deal with, as it is to know the names of the people we deal with, and yet one would scarcely think of learning the names of all the people he or she might see in a great city, as a valuable intellectual accomplishment. The thoughtful and thorough study of a plant in trying to identify it often leads to a deeper interest in it and its relationships. Then if the study is pursued with genera and the higher groups, with a view to determining their derivation and connection and the laws which control their development, some real benefit may be derived and an addition made to human knowledge.

EXPLANATION OF PLATE: Fig. 1.—A, *Secotium warnei* Pk.; B median vertical section of same; C and D, spores magnified; E, portion of the trama. Fig. 2.—A, median vertical section of *Lycoperdon gemmatum* Batsch. Fig. 2.—B shows smaller specimen of the same; C, spore; D, portion of a thread from the capillitium; E, the porous subgleba; F, the gleba. Fig. 3.—A, *Geaster triplex* Jungh.; B, the outer peridium; C, the inner layer of the outer peridium; D, the stoma or opening from which the spores escape; E, the inner peridium; F, a thread of the capillitium; G, a spore more highly magnified than the thread F. Fig. 4.—A, *Scleroderma geaster* Fr.; B, a spore much magnified. Fig. 5.—A basidium and spores of *Tylostoma mammosum* Fr. (after Schröter); A, the basidium greatly magnified.

Studies in Plant Physiology—II.

The Kinds of Work Carried on by Plants and the Manner in Which it is Divided Among the Members.

DR. D. T. MACDOUGAL.

In accomplishing the purpose of its existence a plant is compelled to do a large number of different things, or carry on a variety of processes. Chief among these are the absorption of material from which food may be constructed, from the soil and air, the conversion of these substances into compounds suitable for food, the assimilation of this food into the living substance, building up and enlarging and changing the form of the body, storing up surplus food for future use, carrying material from one part of the body to another, digesting the reserve food when it is to be used, breathing, throwing away wornout or useless material, placing and holding the body in the proper position, and finally taking care that its kind or species is not exterminated by forming numbers of new individuals by means of seeds, offsets and other bodies for reproduction. Then outside of this internal work, the plant must also adopt certain devices for protection against outside forces. In the lower plants all of these kinds of work are accomplished by a very simple body, and indeed in some instances by a single cell. The essential character of the "higher plants" consists in the fact that they have developed separate portions of their bodies in such manner that each is devoted to one or a few kinds of work. These separate portions of the body are termed *organs*, and the work done by an organ constitutes its *functions*. Thus the root, stem, leaves and flowers are each responsible for certain activities which are necessary for the welfare of the plant. Then if we look into the structure of these large organs we will find that they are composed of a number of different structures or tissues, each of which bears a definite share in the work alloted to the organ of which it forms a part. It will be found most convenient to take each organ in turn and learn what we may concerning the things which it is capable of doing.

THE ROOTS.

It was found by a previous experiment that the substances of which the plant is composed are in the soil and air. It needs only the merest glance to satisfy ourselves that the roots are the organs which are in contact with the soil, and that they probably take up the minerals and water it contains. To demonstrate this, however, we must note the character of the soil and the structure of the roots, and see the relation of the two to each other.

EXPERIMENT 5. Examine half a cup full of soil taken from the garden by means of a hand lens, or spread it on a sheet of glass and hold in a strong direct light. If it is separated out into small portions with a needle it may be seen to be made up of a great number of bodies of irregular shapes and sizes, bits of rock, fragments of leaves, stems, seed coats, splinters of bone, feathers, cast-off shards of beetles, and, in fact, almost anything may be found in the soil. Each particle has a faint shiny or glistening appearance. This is due to the fact that it is coated by a very thin layer of water, and it is this water that is used by the plant, for it contains the salts from the soil in solution.

EXPERIMENT 6. Grasp the stem of a sunflower, geranium, or some small plant and attempt to pull it out of the ground. A great amount of force will be found necessary. Try to accomplish the same thing by pulling sidewise on the stem. It will be found even more difficult. Now tie a strong twine cord around the stem of another plant, pass the string up over a heavy branch of a tree or the top rail of a fence. Tie weights or heavy objects to the free end of the cord, and add to them until the plant is torn from the ground. How many pounds were necessary? The plant comes away with a mass of earth adhering to the roots. It is seen as a result of this test that the roots are organs of *fixation* and are designed to hold the plant firmly in its place resisting the action of wind, rain and water currents or the action of animals.

EXPERIMENT 7. Examine the full grown roots of a hyacinth, calla, or Jack-in-the-pulpit. A short distance back of the tip the surface appears to be wrinkled. The wrinkling is due to the fact that the root elongated as it grew, and then when full length had been attained and growth had ceased the older part of the root shortened. If ink marks were placed on your roots and the distance between them measured before and after the wrinkling, it would be found that many roots shrink 10 or even 20 per cent of their length. That is to say, that a root 5 inches long may shrink to four and a half or even four inches. The effect of this shortening may be seen by reference to the diagram of a root system in figure 1. If the root is fastened at B and the portions A A A A contract or shorten, the rootlets L L L L will be brought nearer together and the rocks or soil between clamped so firmly that the plant can not be torn from its place without breaking the rootlets.

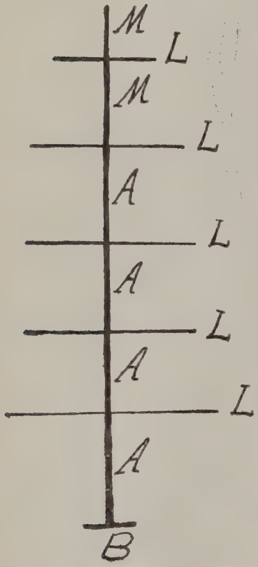

Fig. 1.—Diagram to illustrate clamping action of a root system. B, base of root. A A A A, portions which have contracted. M M, growing regions. L L L L, rootlets or branches.

EXPERIMENT 8. Pull up a seedling of the bean or any convenient plant, and examine the roots after the masses of soil have been shaken loose. A layer of dirt is seen to adhere to the roots without being clamped by the action of the branches. Examine still more closely with a hand lens. The minute particles of soil appear to adhere not to the body of the root, but to glistening threads or tubes arising from it. These are the root-hairs. Thus it is to be seen that the roots act mechanically on the soil in two ways, by clamping large masses and by adhering to the small particles in contact with it by means of the root-hairs.

EXPERIMENT 9. Pour enough water into a tumbler to make a layer a half inch deep. Cut enough circles of cloth or blotting paper to take up this water when placed in it. Drop a dozen seeds of wheat or oats on the blotting paper and cover the tumbler with a saucer. After germination has proceeded so far, two or three days later, that the roots are an inch or two long, take up one of the seedlings and hold between the window and the eye. Innumerable fine hairs or tubes are seen projecting from the roots in all directions. If these were examined with a strong lens they would be seen to be small tubes. These tubes are of the shape of a finger of a glove, and when thrust in between the hard particles of the soil they take irregular shapes and adhere to the bodies which they touch.

EXPERIMENT 10. Remove a young sunflower from the ground and roughly shake off all the soil. If this is thoroughly done the root-hairs will be broken off and carried away with the soil particles. Now carefully replace in the soil. The plant droops and finally wilts no matter how much water is poured over it. It appears to be unable to take up water after the root-hairs have been broken off.

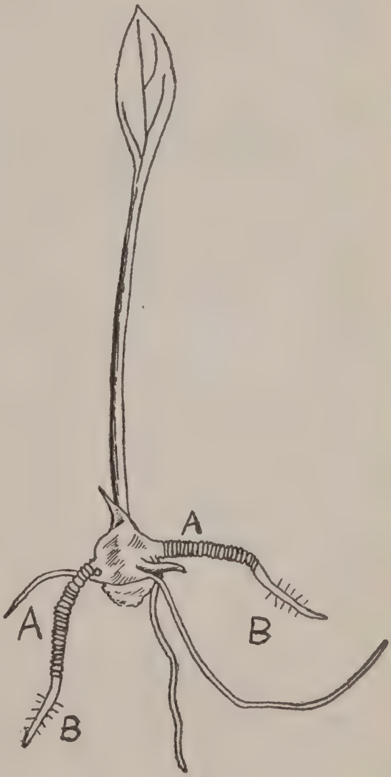

Fig. 2.—Seedling of Arum. A, portion of root which has undergone contraction. B, region of root-hairs.

EXPERIMENT 11. Place a young potted plant of tomato or geranium where it may not receive water. When it has wilted from thirst, invert the pot over a bucket of water with the leaves immersed, but being careful not to wet the roots or soil. After an hour replace the plant in its natural position. Has it recovered from wilting? Can it take in water through the leaves?

Method of Teaching Botany in the Secondary Schools.

GEO. F. ATKINSON.

Since the Editor has requested me to write this article, I think I could do no better than to say that my judgment and experience on this question are set forth in my Elementary Botany, recently issued by Henry Holt & Co. In the preface to that book I have endeavored to give my reasons for the method there followed, and the plan was more fully elaborated in a paper read at the 35th Convocation of the University of the State of New York, held in Albany in June, 1897. This paper was published in the *Regent's Bulletin*, No. 42, August, 1897.

My experience has been gained in teaching a class of 60 to 70 students for several years. The larger number of these students are in the general academic courses, and only study botany for one year, while a small percentage pursue advanced work in succeeding years. The majority of the students have never studied the subject before. So that the problem of teaching botany to this class is precisely the one which confronts us in dealing with the subject in the secondary schools, namely: What is the best general method of teaching botany to a class of pupils, the large majority of whom will only study the subject for one school year or part of a year?

While the traditional method of teaching botany in the secondary schools, the "analytical method" applied to the flowering plants, still has its advocates among teachers, there is general dissatisfaction with it. The method as generally practiced is so wanting in cultural value, and void of science method, that it is in "bad repute," and those who are not familiar with the awakening which has been brought about in the "new botany" during the past decade or two, through the great progress in plant morphology and plant physiology, have had a growing contempt for the science, if not for those who pursue it.

While in the hands of competent and progressive teachers the so-called "analytical method" may not be wholly without some good results, it does not meet the requirements of the present age for cultural training in science method. To the large majority of pupils in the secondary schools it is either a means only, or a means to a single end, in which there is, for but a few, a little profit. Organography in itself is meaningless, and organography for the sole purpose of "keying" plants is too colorless and too technical a process, except for the specialist or the amateur taxonomist. In the light of our present knowledge of plants it is just as unwise to confine the pupil in a course for general culture to taxonomy, as it would be in zoology to study only the classification of birds, in physiology to study only the effects of alcoholism, in physics to study only electricity, or in chemistry to study only the organic compounds.

We are realizing nowadays that for general culture in the sciences, general and fundamental principles and laws are most important; they are in harmony with the best accepted ideas on methods of pedagogy, and certainly they should precede any specialization in the subject.

The method which I have found successful is to begin with a study of the vegetative life processes of plants, or physiology, thus dealing largely with function. Since some knowledge of form must accompany a study of function, the pupil gains by necessity some knowledge of morphology while studying life processes. Furthermore, in this study emphasis is laid on the broader and more general phenomena, like osmosis, absorption. diffusion, turgescence, nutrition, carbonic acid assimilation, respiration, growth and irritability; considering as of secondary importance of the multitude of more special phenomena of adaptation, for which there is not time to deal with in detail, but perhaps to give only a few examples.

The first lessons are practical studies on protoplasm, since this substance is fundamental to not only the physical phenomena of absorption, etc., but to the life processes as well. In these studies of protoplasm, and the life processes, plants are used from among the algae, fungi, liverworts, mosses and the higher plants, to show that these things are fundamental. Incidentally, however, the pupil is becoming acquainted with a number of the algae, fungi, liverworts and mosses, plants probably about which they have previously known nothing.

Following life processes, the general subject of morphology is taken up, not morphology in the special sense of organography, but morphology in the broadest sense—studies of representative plants of the various groups, the life history, reproduction and relationship. In doing this the groups are taken up in the following order: Algae, fungi, liverworts, mosses, ferns and their kind, gymnosperms, angiosperms. This is considered to be the natural sequence, to proceed from the lower and simpler plants to the higher and more complex.

Some educators, I am aware, favor beginning with the higher plants and proceeding to the lower. In support of this procedure they quote what they choose to call a "pedagogical principle," that one should "proceed from the known to the unknown," arguing that every one knows something about the higher plants, and therefore it is better to begin with them. I have often wondered if the advocates of this principle would insist on applying it to infants; so far as I know, it is universal for infants in acquiring knowledge to proceed from the unknown to the known, thus contradicting in their experience the theories of the learned pedagogue.

There is, however, a measure of reason in pointing to the difficulties which are met with in beginning the study of representative plants of the different groups at the lower end, i. e., with the lowest and simplest plants, because they are usually entirely unfamiliar to the beginner; the difficulties are met in endeavoring to learn new names, form, processes and classification all at once. These difficulties are due, I believe, not to the fact that the plants are entirely unknown, but because too many unknown things are studied at once, i. e., the pupil attempts not only to make the acquaintance of the unknown plant, but to study its form, manner of growth, nutrition, reproduction, and classification, so that the large number of new facts, all not closely related, tends to bewilder. I have found that it is immaterial at what end of the series the young pupil begins; the difficulty is the same when the lower plants are reached.

It is to obviate this difficulty that I first study life processes, and in doing so employ the lower plants as well as the higher ones for the practical studies. This gives a familiarity with a number of the lower plants, and when studies in morphology are begun, the student finds that he is dealing with known objects in many cases, if a judicious choice of plants under the various topics has been made. A third period is devoted to a study of relationships among plant families, selecting the angiosperms, because here is found the most common and suitable material for such a first study.

Then the relationship of plants to environment should not be overlooked, and topics under the head of seed distribution, adaptation of plants to different conditions of the seasons, to variations in soil and moisture, the effect of environment on plants, as well as the effect of plants on their environment, can be arranged for study on suitable occasions for excursions.

Pursuing this method, the student acquires a knowledge of the fundamental laws and principles of the science of botany. The topics are arranged so that in physiology they represent *progression of function*, and in morphology so that they represent *progression of form*. Weekly lectures are given, and also laboratory talks upon the special work of the session, and the student is taught to perform the experiments, bring together the data, and also to draw correct conclusions from them.

From this point the student, if he wishes to pursue botany further, is ready for advanced studies in various lines, or for taking up studies relating to agriculture or horticulture. But those who, like a majority of the students in the secondary schools, will never study the subject further, will have gained some knowledge of the fundamental principles of plant life and relationship which will help the mind to adjust itself better to modern science and modern thought. Further, I believe that if the student largely forgets the details of the study, and I should hope that that would not be the case, he can not lose the method of procedure in search for truths. It becomes a part of the moral being and gives power to the individual, which is applied, unconsciously it may be, to the life work in whatever channel that may flow.

Shorter Articles.

Notes from the Washington Mycological Club.

The club has recently enjoyed several "feeds" on dishes made from *Boletus castaneus*, *B. brevipes*, *Armillaria mellea* and *Russula alutacea*. "Blewitz" (*Tricholoma personatum*) has been very abundant during the late autumn months in several localities about Washington, and many can testify to its excellent edible qualities.

Owing to the dry season the fall fungi were late in coming, and consequently when the freezing weather came many were "frozen in their tracks."

Several members of the club report having tested the edible qualities of *Tricholoma equestre L.*, which, notwithstanding its color and not very appetizing smell, has really a fine flavor, and proved harmless.

Tricholoma terreum, with its numerous varieties, is also recommended by a number. This ought to be quite an important mushroom, since it is very abundant and often of large size. It is also quite easily freed from dirt, a strong recommendation and one that will find favor with the cook. As much can not be said of *Tricholoma transmutans* Peck. With us this year it was small and dirty, though from its habit of growing in rings it was not a hard matter to get quite a quantity in a very short time.

The writer has found the greatest satisfaction this season in stews made from *Russula alutacea.*

"Boletus soup" is another enjoyable dish, the species most commonly used being *castaneus* and *brevipes.* For soupmaking the pores need not be removed, the soup having much the consistency of that made from okra.

All fungus lovers should add to their winter's food supply a number of bottles of mushroom catsup. This can be made at a trifling cost at the time when fungi are most abundant. Any edible fungi that are in good condition may be utilized. For catsup the parts generally discarded, as the stems, the pore surface of boleti, etc., should not be thrown away. In their season puff balls are as good as any other fungi for this purpose, and can be prepared quickly and easily. They should be washed or otherwise cleansed from grit, and then chopped fine, and about one-half of a pound of salt added to each peck of mushrooms. After being thoroughly mixed with the salt, they should stand in a warm place for about twenty-four hours, and be frequently stirred. They should then be pressed through a jelly bag, strained the second time, if necessary. To this should be added one-quarter ounce of cayenne, one-half ounce of allspice, one-half ounce of ginger and two blades of pounded mace, and the whole put on to boil in a porcelain kettle. Boil for an hour or so, strain, and seal hot. A little good vinegar may be added or not, as desired. Store in a cool place. If a mould forms on top of the catsup it should be reboiled with a few grains of pepper. Mushrooms for this purpose should not be gathered during a rain, or if they are, should be boiled a much longer time.

MABEL E. WILLIAMS, Curator.

Mushrooms with Tomato Sauce.

The following recipe has been found so excellent that it is offered to the readers of the Bulletin. The mushrooms used were

Hypholoma sublateritium, Schaeff, which is very abundant in late autumn about the base of old stumps throughout most of the Northern and Eastern States. Other species may do equally well, but those having a firm texture are best.

Take one quart of well-cleaned mushrooms, place over the fire in a stewpan. Let them come to a boil in their own juice, then add one cupful of tomatoes and one-half teaspoonful of mustard, rubbed smooth in water, season well with salt and pepper, and cook well for half an hour. About five minutes before serving add a tablespoonful of butter. Serve hot, and you will find you have an appetizing dish.

This mushroom keeps well, prepared as above and placed in sealed vessels.

Mrs. C. L. Shear.

Albino Flowers.

There seems to be much interest among your readers concerning albinos, so I will add my mite of observation on these forms in Nebraska:

Viola obliqua—A large patch of large plants at Atkinson last May, making a striking picture.

Viola pedatifida—Quite abundant at O'Niell.

Cleome serrulata—A single plant at Gordon.

Lathyrus ornatus—A patch of about four square rods on a dry knoll, surrounded by plants of the normal color. Valentine.

Spiesia lamberti—A single plant near Valentine.

Pentstemon grandiflorus—One or two plants. Valentine.

Pentstemon angustifolius—A single plant at Valentine.

Verbena hastata—Rare. Valentine.

Lacinaria squarrosa—Rare. Kennedy.

There is no apparent cause for these changes. The only observation I can make is that they all take place in bluish or purplish flowers. I do not recall a yellow-flowered plant producing an albino. The former colors are easily lost in the press and the herbarium, while yellow is a fast color. J. M. Bates.

Editorial.

It is with deep regret that we announce the untimely death of Mr. Gilbert H. Hicks, Editor of the *Bulletin*. Mr. Hicks died suddenly at his home in this city on the 5th of December. He had been sick but a short time, and was thought to be recovering, when he was suddenly taken worse, and died in a few minutes.

The next number of the *Bulletin* will contain a portrait of Mr. Hicks and sketches of his life, written by two of his most intimate friends and associates.

The death of Mr. Hicks necessitates a change in the editorship of the *Bulletin*, but the journal will be continued along the lines indicated in the editorial in the October number. The present editors are in accord with Mr. Hicks' plans for the development and direction of the paper, and hope for the same hearty support and cooperation from all the friends of the *Bulletin* that have been given to it in the past. No pains will be spared to make our journal the best of its kind, useful to the teacher, the amateur and the professional botanist. May we not have your support, your subscription?

News and Notes.

Dr. Edward Palmer, the veteran Mexican collector, has just returned with a large and valuable collection, much of it being of economic importance. He had intended to return sooner, but was detained by quarantine and sickness.

The Washington Botanical Club was organized November 11, with 14 charter members. At its first regular meeting, December 14, Dr. E. L. Greene was elected president, and Mr. C. L. Pollard secretary for the coming year. Greetings and well wishes were received from the Torrey Botanical Club, of New York City.

Mr. D. G. Fairchild, special agent in charge of seed and plant importation in the U. S. Department of Agriculture, has left for an extended journey through South America in search of plants desirable for cultivation in the United States. O. F. Cook, of the U. S. National Museum, will have charge of the work at Washington during Mr. Fairchild's absence.

Mr. A. J. Pieters has been placed in charge of the pure seed investigations in the Department of Agriculture. This is a well-merited promotion; and the fact that he has been so closely associated with Mr. Hicks in this line of work will enable him to take it up where the latter left it with little or no break.

Dr. O. Loew, formerly connected with the Imperial University at Tokio, Japan, and recently appointed to a position in the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture, has arrived in Washington, and begun his investigations.

Prof. D. A. Saunders, of the South Dakota Agricultural College, is spending a couple of months in the South along the Gulf coast, collecting and studying the algae of that region.

The recent action of the Association of Colleges and Experiment Stations, in adopting a committee report, recommending that arrangements be made whereby graduates from the agricultural colleges and others properly prepared, could be admitted to the laboratories and libraries of the various bureaus and divisions of the U. S. Department of Agriculture, to carry on graduate work, is a move in the right direction.

Such a course will bring the Department and the State institutions more closely in touch with one another; it will result in a better appreciation of the work each is doing, and a more united effort for the future along all lines of education and research connected with agriculture.

Recent Literature.

C. G. Lloyd has recently published a second paper of his series of studies on fungi. It contains notes on a number of rare species and descriptions of the large Lepiotas in the vicinity of Cincinnati. It is hardly necessary to repeat that these papers are of great value to all students of the fleshy fungi, and particularly to beginners. May we not suggest to the author that the usefulness of "Mycological Notes" would be increased if the authorities for the specific names were added? Those who have not already received a copy should lose no time in making application for it to Mr. C. G. Lloyd, Court and Plum streets, Cincinnati, O.

M. E. W.

Ginseng, Its Nature and Culture. This is the title of Bull. No. 78 of the Kentucky Agricultural Experiment Station which has just come to hand. The plant, Panax quinquefolium, is treated from a purely economic standpoint, and much information regarding its culture is given. The paper is illustrated with 10 half-tone plates, showing the plant and its parts.

C. L. S.

Students and teachers of plant physiology will welcome with delight the English edition of Dr. Detmer's "Practical Plant Physiology," just published by The McMillan Co., of New York City. This translation will make the work much more available to English speaking students, and the high reputation already gained by the German editions will insure it a wide sale. The clearness of the language in which the book is written, and the simplicity of the apparatus required in performing most of the experiments, make this a thoroughly "practical" work, particularly valuable in the elementary courses of the smaller colleges and secondary schools. The price of the volume is placed at $3.

T. A. W.

Prof. I. Urban has recently begun the publishing of an extensive work on West Indian botany under the title of "Symbolae Antillanae seu Fundamenta Florae Indiae Occidentalis." This is to be a comprehensive work, including the results of the study of West Indian plants by Urban and others. Its appearance is timely on account of the great interest being taken in this region at present, and it will prove a valuable aid in further researches in the very interesting flora of the region. The first fascicle has already been issued, and deals entirely with the bibliography of West Indian botany. It is published by the Gebrüder Borntraeger, of Berlin. The same publishers have also just issued a very neat little "Botaniker Kalender," by P. Sydow, which contains among other things valuable information regarding the great botanical collections in the various countries of the world, and the museums, and botanical gardens where they are preserved. T. A. W.

Under the laws of Morphology, a complete flower is but modified leaf-blade and branch. If we can imagine a long coil of wire drawn in so close that the spirals touch each other, we may form some idea how nature draws in the longitudinal growth of a branch to form a flower. At times the branch objects to this summary proceeding, and after being arrested and even the parts of the flower formed, will escape from the bondage and journey on as a well-ordered branch should. Mr. Egan sends a branch of a moss rose that has fought for freedom in this way. A few good, clear petals had been formed, when the whole central portion started off on its journey as a perfect branch again. Those who have sharp eyes occasionally meet instances of this behavior in the rose and other plants. These departures are very instructive to the curious in the secrets of nature.—Meehans' Monthly for December.

The curious protuberances or "knees" from the roots of the Southern Cypress are well known. Mr. W. C. Egan sends a sketch of a similar "knee" thrown up by an akebia. It is from near the collar of the plant, and is about 1½ inches high, and half an inch wide at the top—a pretty good size for so small a root. Just what service these "knees" serve in the economy of the plant is still a question. Many have tried their hands at writing explanations, the writer among others; but as time brings experience, there seems room for doubt that they have been really explained.—Meehans' Monthly for December.

Important Notice.

We desire to announce that owing to the many improvements made in the current volume of the *Fern Bulletin,* the price of sample copies will now be 15 cents each. Purchasers of sample copies may deduct this sum from the regular subscription price when subscribing. The January number contains fourteen articles on ferns, many shorter notes, and eight pages devoted to the mosses. Send for it. Address,

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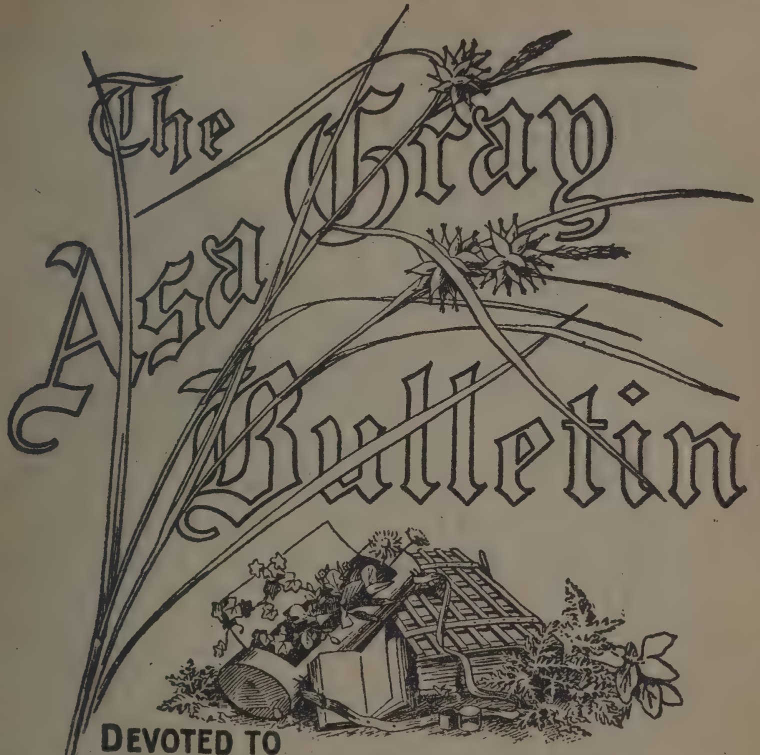

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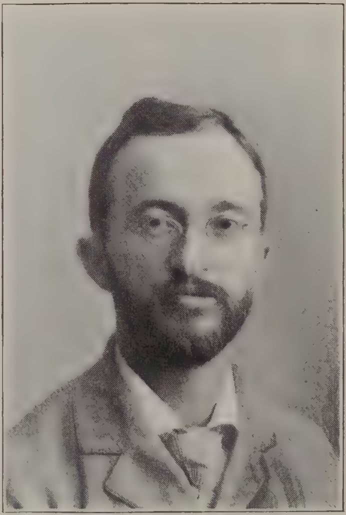


GILBERT H. HICKS.

Asa Gray Bulletin.

VOL. VII. NO. 1. FEBRUARY, 1899. Whole No. 29.

Gilbert H. Hicks.—(Plate I.)

BY ERWIN F. SMITH.

Mr. Hicks was born at Owosso, Mich., in 1861. His parents still live. His father is a clergyman of the M. E. church, settled in Michigan. His mother, a woman of much firmness of character, is the daughter of an Ohio farmer. His younger brother is Professor of History and Political Economy in the University of Missouri.

He graduated from the Corunna, Mich., High School in 1879, and in 1882 married Miss Elva Etschmann, a graduate of the same school and class, who, with two young children, survives him.

On leaving the High School, he entered Albion College, where he remained two years, continuing his classical studies. Thrown on his own resources, he then began railroad work as an assistant in a freight office. Having learned telegraphy, he was soon made station agent at Oakley, Mich. After a time he was promoted to a more responsible place at Chesaning, Mich. The desire to complete his college course never entirely forsook him, and it became so strong while he was at Chesaning that, although married and poor, he resigned his position and went back to Albion College. But things were not as of old, or at least not as haunting fancy had pictured them. His classmates were gone, and along with them had departed the old, delightful times. Greek and Latin had lost their former charm, and after a half year of plodding college life he decided that the workday world was, after all, the place for him, and went back to the railroad life. With this short interruption, he was employed continuously in railroad work from 1881 to 1890, having served the Michigan Central Railway Company faithfully as station agent at Oakley, Chesaning, Grayling and Owosso Junction.

During all these years the love of books and of nature and the ambition to do something better slumbered not. Every spare moment was given to study, especially to the study of the flora around his stations, one of which was in the curious and interesting pine barrens of Michigan. In these years he began, with various scientific men, correspondences which afterwards ripened into sincere friendships.

Mr. Hicks possessed excellent business ability and had the full confidence of the railway company, but he had tastes and aspirations which no business success could satisfy. These finally led to what must be called a turning point in his life. In 1890 he threw up his position as station agent, deciding definitely to abandon railroad work and to give his whole energy to science, although no means of a livelihood was in sight. He first went to the Michigan Agricultural College, where he graduated with honor in 1892, acting meanwhile as assistant to the Professor in Botany. Not satisfied with the botanical training offered in this school, he next went, in opposition to the advice of friends, to the University of Michigan, where he spent two winter vacations in the botanical laboratories—periods of very hard study to which he often afterward referred as among the most pleasant and profitable of his life. In the winter of 1893, while at the University of Michigan, he passed a Civil Service examination, and in January, 1894, was appointed to a subordinate position in the Division of Botany of the United States Department of Agriculture, which place he filled so satisfactorily that he was soon made First Assistant in Botany.

During the four years in which Mr. Hicks was connected with the Department of Agriculture he had the entire responsibility of the seed inspection work under two Secretaries of Agriculture, and applied himself so energetically and assiduously to the building up of his section of the Division that it soon commanded the attention and respect of the whole Department. There was practically nothing in the Department in the way of a seed collection when he began his work. At the time of his death this collection numbered over twenty thousand entries, and the method and neatness of the exhibit attracted much attention. He also extended his influence to each one of the experiment stations by sending out sets of properly named and labeled seeds collected from all parts of the world. These sets consist of the seeds of five hundred species of economic plants.

Mr. Hicks' taste for natural history developed very early. His first formal introduction to botany is said to have begun in the Corunna High School in 1876, but as a boy he had long been familiar with many plants and animals. From his earliest childhood he had made little collections of beetles, butterflies, and other natural objects, and would often come running in from the fields with his face aglow and his hands and pockets full of his newly discovered treasures. The boy was father of the man. This spirit of the scientific collector never forsook him. To the end of his life he was very fond of the woods and fields and had a keen eye for objects new or interesting to science. One result of these explorations, in recent years, was much needed rest and recreation; another was a well-filled herbarium. He was especially attracted to the study of fungi, and followed seed investigation because there happened to be an opening for him in this line, rather than because he had any special liking for it. Of late years he frequently complained to the writer of the heavy burden of his administrative work, which robbed him of time he earnestly coveted for the critical study of the things which interested him most. Nevertheless, he was always cheerful and hopeful of better things.

Mr. Hicks began his professional scientific work rather late in life, with an imperfect training and under difficulties which would have discouraged a weaker man. To offset these things he had a profound love for his work, indomitable energy, great confidence in himself, and marked ability.

At the time of his death he was engaged on a Manual of Seeds and Seed Growing, to be published by the Macmillans. He was well prepared to write this book, both by reading and by experiment. The plates are finished, and he left voluminous notes on the subject, but they are not in such shape that any one but their author could make a book out of them. He also left interesting notes and memoranda on a variety of subjects, and could he have lived a few years longer would unquestionably have placed his scientific reputation on a very solid and enduring basis. No one who knew him well can doubt this. He had all the qualifications necessary to the successful pursuit of science. The ambition to accomplish something worthy was with him a consuming fire. That he persistently overworked can not be denied; much of this work was, however, forced upon him as a result of his professional position, and could not well be avoided. In any event, is it not better to wear out than to rust out? Are not fifty years of Europe, or even thirty-five, better than a cycle of Cathay? He did what he thought wisest and best to do, and up to the very last half hour of his life was busy with his beloved work. If truly, as the poet says, 'we live in deeds, not years; in thoughts, not breaths; in feelings, not in figures on a dial," then Mr. Hicks, cut short in the midst of his activities, has lived more truly and to better purpose than many a complacent individual of four score and ten.

Mr. Hicks had many friends in Washington, and was well known personally or by correspondence to a large circle of scientific men outside of this city. His sudden death in the prime of life is a matter of lasting regret, not simply because it removes a man of scientific ambition and ability, but also because men with his force of character and his congenial spirit are not so common in the world as to be spared without a pang.

Unlike many scientific men, Mr. Hicks could talk on something besides his hobby, and never bored his non-professional friends. He realized that botany was not all of existence, and was not so much a man of one idea as to lose his sense of proportion. In his high school and college life he had been a diligent student of the Classics, and understood the meaning and value of culture. He was always in love with letters and was familiar with many of the best English books. He had made good progress in French and German, so that the literature in these languages was at his command. He also read Italian in a plodding way, and recently he had begun the study of Spanish. He was fond of history, of poetry, and of fiction. Whittier was his favorite poet, and Thackeray his preference among novelists.

Mr. Hicks was of medium height, slender rather than stout, erect in carriage, very active in his movements, a little brusque in his manner, and incisive in his speech. His eyes were hazel, his hair and beard were inclined to rufous, especially the latter, and his forehead was large.

He was sociable, simple in his habits, quick to appreciate a joke, a lover of tobacco, fond of dogs, a reader of newspapers and magazines, fond of base ball and of the theatre, diplomatic, ambitious, optimistic, prompt in the dispatch of business, loyal to his friends, a hard student (far too hard at times), and as eager to see and to hear new things as any old Greek.

Mr. Hicks' early training was strongly religious. He was quite active in the work of the church and Sunday school up to and during the time of his railroad life, and it is said that at one time he studied Hebrew and had thoughts of becoming a clergyman. Later he became more liberal in his views, and while not breaking with the church, preferred to spend his Sundays in study or on long collecting trips in wood and field. Who shall say that these excursions did not bring him into equally close communion with the great Father of us all? The questioning spirit was his, the refusal to take things on "authority," as must necessarily be the case with every man of science. Nevertheless, he recognized very clearly that man lives not by bread alone, and was always devout in the best sense of the word, hoping for a larger life to come. The simple faith in God that breathes through the Gospels, and which has reached its highest modern development in "In Memoriam" and in some of Whittier's poems, was his faith. With Tennyson he could say:

"Let knowledge grow from more to more,
 But more of reverence in us dwell;
 That mind and soul according well,
May make one music as before,
   But vaster."

Resolutions of the Botanical Seminar of Washington on the Death of Gilbert H. Hicks.

Whereas, In the providence of God, our friend and co-worker, Gilbert H. Hicks has been removed from us by sudden death, in the prime of life and usefulness; and,

Whereas, He has been an active member of this Seminar for four years, so that all of us have been brought into intimate relations with him,

We, the members of the Botanical Seminar of Washington, desire to express our appreciation of the kindly, helpful, companionable spirit of the man.

We also wish to note his ambition to achieve a worthy success, his restless activity, his large capacity for organization, his well-balanced mind, his love of nature and out door life, his keen appreciation of literature and art, his sincerity, his devotion to science, his store of botanical learning, and his marked ability in his chosen field.

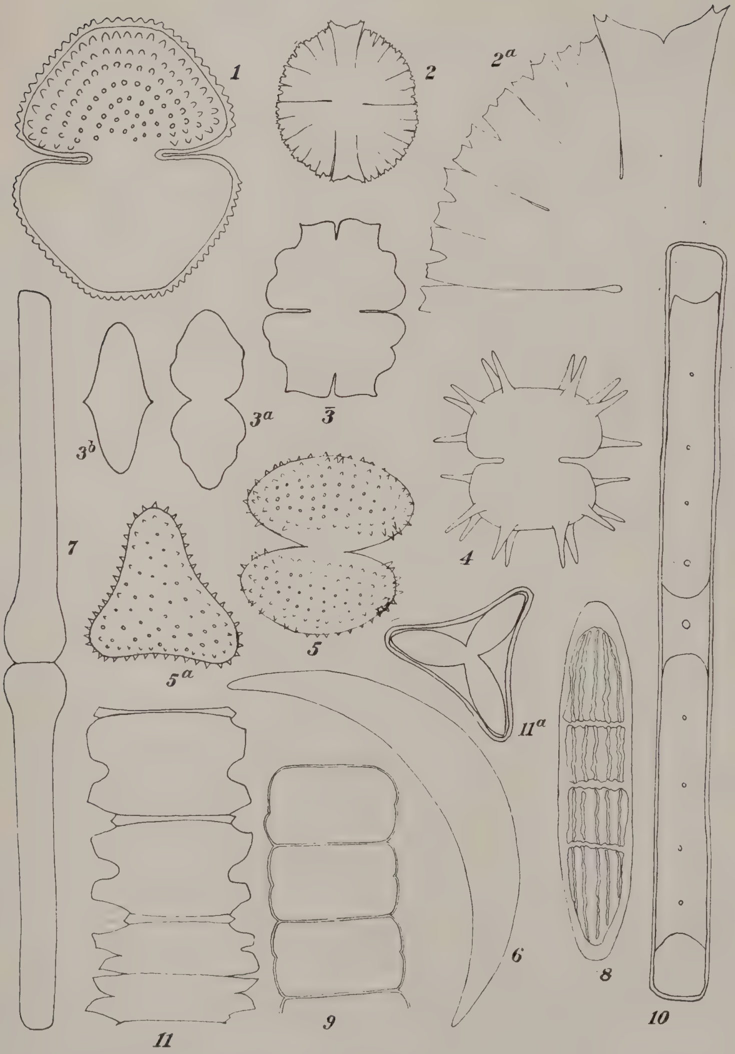
He leaves much unfinished work, and his death is a distinct loss to science. To the members of this Seminar it is also a personal loss, and comes as an unexpected and inexpressible shock. We recognize the uncertain and transitory nature of all things human, and bow to the inevitable, but will ever hold our comrade in grateful recollection as one worthy of esteem and friendship.

Resolutions of the Michigan Agricultural College Alumni Association of Washington on the Death of Mr. Hicks.

We, the members of the M. A. C. Alumni Association of Washington, learn with sorrow of the death of our fellow member and associate, Gilbert H. Hicks, of the class of '92.

As an earnest and thorough student and a faithful and painstaking instructor at the Michigan Agricultural College, and as an active participant in all of the proceedings of the Alumni Association during his residence here of nearly five years, he won the respect, esteem and warm personal friendship of all who came to know him.

ASA GRAY BULLETIN VII.—PLATE II.



1. *Cosmarium botrytis*; granules shown on only one half.
2. *Micrasterias rotata*; (a) one quarter much enlarged.
3. *Euastrum elegans*; (a) edge view; (b) end view.
4. *Xanthidium.*
5. *Staurastrum*; (a) end view.
6. *Closterium parvulum.*
7. *Docidium.*
8. *Penium interruptum.*
9. *Hyalotheca dissiliens.*
10. *Gonatozygon*; one cell much enlarged; these cells occur in filaments.
11. *Desmidium*; (a) end view.

We deplore his loss to ourselves as a faithful friend and counselor, and to our Alma Mater as one of her loyal sons whose achievements already redound to her credit, and whose work in a comparatively new field of economic science gave promise of a brilliant future.

We tender to his bereaved family our heartfelt sympathy, and invoke in this time of their affliction the divine compassion of the Heavenly Father, who alone can heal the broken heart and bind up the wounded spirit.

[Similar resolutions and expressions of sympathy were adopted at a meeting of the members of the scientific force of the U. S. Department of Agriculture and by the Washington Mycological Club, of which Mr. Hicks was vice-president, and by other clubs of which he was a member.—Eds.]

Fresh Water Algae—I.

The Desmids.—(Plate II.)

A. J. PIETERS.

The study of fresh water algae is to many botanists an almost unknown field. This is especially true of the Desmids, which are usually passed without notice, though they are common in all pools and bogs. In many of our higher schools, where Spirogyra and other filamentous algae are studied, Desmids are comparatively unknown. This is perhaps due to the fact that in Desmids the zygospores, which are the result of sexual reproduction, are less common than in the filamentous Conjugatae, to which is usually given all the time allotted in school work to this group. This is greatly to be regretted, because the Desmids are far the most interesting to that large class of plant lovers who can devote only their spare moments to the study of vegetable life. They are the most easily preserved of the fresh water algae, can be collected almost everywhere, and are identified from their vegetative states. Besides this, their endless variety and beauty of form makes their study a constant source of delight. Scarcely a collection but what will furnish species new to the collector, if not, indeed, new to science.

The literature of Desmid lore is extremely voluminous and unfortunately much scattered. Papers have been published in nearly every botanical and microscopical journal for the greater part of this century, and in nearly every European language. Much has been done to bring together descriptions and illustrations of species in form accessible to English speaking students by Ralfs, Cooke, and Wolle. Besides these general works in English, Delponte and Turner have gathered together illustrations and Latin descriptions of many species, and DeToni, in the Sylloge Algarum, has published Latin descriptions of all species known in 1889. Wolle's Desmids of the U. S., first published in 1884, is the only comprehensive work we have on American Desmids, and in spite of the many errors it is indispensable to the American student of this group.

Thirty-one genera are recognized by Engler and Prantl, of which ten may be said to be common in American waters. Of these five are large genera, containing many known species, and doubtless many others that remain to be discovered.

The Desmideae form a subfamily of the Conjugatae, being closely related by their sexual reproduction to Spirogyra and Zygnema. They are unicellular algae, the cells mostly free swimming, but sometimes attached in rows making filaments. In *Hyalotheca dissiliens* the filaments are coarse, easily seen with the naked eye, and look in mass much like a large Spirogyra. The filamentous condition is usually a generic characteristic, but in some genera in which the species are commonly free swimming, one or more species have a filamentous habit.

The most distinctive character of Desmids is their bipartite structure. Each cell is made up of two semi-cells which are nearly duplicates. In such species as Cosmarium and Micrasterias the separation is very marked, the semi-cells being connected by a narrow neck. In Closterium there is no constriction, but the division into two similar halves is not the less evident.

In Penium and in the filamentous Gonatozygon the division is less well marked, but can be seen in a break in the chlorophyll band.

The arrangement of the chlorophyll is usually a generic characteristic. In Cosmarium there are one or two masses in each semi-cell; in Hyalotheca the chlorophyll band is axial, and several branches radiate from the center; in Closterium there are one to several longitudinal bands, while in Spirotaenia and in Genicularia the bands are spiral.

Reproduction takes place either by a simple cell division, or by conjugation, producing a zygospore. In simple cell division the semi-cells separate and a new semi-cell is formed at the free end of each half. Conjugation takes place when each of two cells lying near each other sends out a process toward the other cell. When these processes meet the walls are dissolved at the point of contact, and the contents flow into a sac formed between the two cells. This sac increases in size and finally forms the zygospore. The mature zygospore is in some genera provided with spines or prickles, while in other genera it is smooth.

The wall of the Desmid cell is firm, resisting some pressure, and not losing its shape under the action of the usual preserving fluids. In some Closteriums there is a deposit of mineral matter in the shell, so that when burned the outline of the cell remains. The outside of the cell wall is frequently ornamented with granules, puncta or spines arranged in various ways and frequently adding much to the beauty of the cell. All Desmids are said to have a mucous covering, in some species, as in Hyalotheca, forming a broad sheath around the plant, but in the great majority the sheath is extremely difficult to make out.

Desmids may be collected in nearly every pool of clear water, in ditches, along the margins of slow streams, in springy places in bogs, and even along the shores of the Great Lakes where they grow among masses of Diatoms, which are attached to Scirpus and other aquatic plants. One of the best methods of collecting is to gather carefully such plants as Utricularia, Bidens Beckii or any other fine-leaved plant growing in quiet water, and wash it by shaking in a two-quart fruit can. The sediment will usually be rich in Desmids and can be preserved in small vials of water, to which a few drops of carbolic acid has been added.

To identify the species one must usually obtain more than one view of the plant. The front or flat view is the one commonly seen, but the side and end views frequently show peculiarities which separate the species from closely related ones. Thus a species may have a small central inflation which can not be seen in front view, but which becomes evident at once on securing an end view. The most difficult and patience-exhausting part of Desmid study consists in getting the plant to turn over and remain on edge or on end long enough to get a clear idea of its shape. However, in many cases this is absolutely necessary to a proper understanding of the species.

In any gathering the student is almost certain to find species of Cosmarium and Closterium. These two genera are so large and are so well distributed that they occur wherever conditions are at all favorable for the growth of Desmids. The Cosmariums (Pl. II, fig. 1) may be readily known by their two-parted structure. The neck is usually short, with a deep sinus on each side. The shape of the semi-cell varies from hemispherical to pyramidal, and the surface is either smooth or is ornamented with beads or dots. Four other genera have a superficial resemblance to Cosmarium in flat view, but differ from it in important points. Micrasterias (Pl. II, fig. 2), which is also conspicuously two parted and flat, has the semi-cells divided into lobes. The divisions are often deep and numerous, giving each semi-cell five or more narrow lobes which are sometimes toothed at the end. From Euastrum (Pl. II, fig. 3), which is constricted in the middle and flat, Cosmarium differs in the absence of an incision in the end of the semi-cell, which in Euastrum is often deep, but sometimes merely a notch. The long spines of Xanthidium (Pl. II, fig. 4) distinguish it at once from the other genera, while the end view of Staurastrum (Pl. II, fig. 5), showing two to five (mostly three) rays, is necessary to certainly distinguish it from Cosmarium. In all these genera three views are usually needed to determine a species with certainty. The shape of the semi-cells in side view, the presence or absence of an inflation and other minor points can only be determined by patiently working to get the specimen on end or on edge. This can be done by tapping the cover glass or by starting currents under the cover by drawing off the water from one side.

Another great group of genera consists of the long cylindrical or curved forms. Some like Closterium (Pl. II, fig. 6) have no central constriction, but nevertheless are clearly bipartite. The species of this genus are curved and usually tapering, some of them ending in a long drawn-out beak. Docidium (Pl. II, fig. 7) has an evident, though slight, central constriction and square cut ends, while Penium (Pl. II, fig. 8) may sometimes be taken for a Closterium, since it has no central constriction. It is, however, never curved.

Of the filamentous forms, Hyalotheca (Pl. II, fig. 9) is the most common. It is not always easy to distinguish these from the true filamentous algae. In Hyalotheca each cell has a slight notch in the edge, and in end view the chlorophyll is seen to radiate from the center. In Gonatozygon (Pl. II, fig. 10) the Desmids approach nearest to the filamentous algae. The cells are placed in long chains and the chlorophyll is in bands which are, however, broken or interrupted in the middle. The small genus Desmidium (Pl. II, fig. 11) contains some of the most beautiful species in this group, its long twisted chains of cells being three or four angled in end view.

How Shall We Teach Botany in Our Secondary Schools?

GRACE E. COOLEY.

The first thing to consider in planning any course of study is the aim of that study. Since comparatively few of the students in our secondary schools are to enter college, the question before us resolves itself into this: What is the aim of a study of botany which is not technical?

In planning courses in botany, as brief as those given in our secondary schools must necessarily be, the prominent features should be the training of the eye and heart of the young student, so that he may be not only keenly curious to find out what lies beyond his knowledge, but fitted to explore the unknown regions for himself. We should, I think, seek to show him the way into the field of botanical thought, which he may enter and take possession of later through self-study. The method, then, should be such as shall rouse his interest in plants, secure his attention, engage his affection for growing things, and give into his own hands the means for gratifying his tastes when they are formed. This training will give him possibilities for constantly widening his horizon; give him, as well, a constantly growing enjoyment in life, and the means for rest and refreshment in his hours of leisure.

We are all essentially animals in that living out of doors is natural to us, and therefore relaxing and refreshing. Indoor life is abnormal and debilitating. Provided with a stimulus to be out of doors, a man is able to secure relaxation from the strain of his more or less artificial life in a simple and natural way. The effort to train the mind and heart of a child so that an acquaintance with nature begun at school may ripen into a friendly, confidential fellowship with growing things will at least make the man's own life richer, and he may, as history repeatedly shows, help to enrich the world. Many names of well-known naturalists come to mind who took up nature-study as a relaxation from the demands of their proper business.

Chas. Kingsley's sermons have been mostly forgotten, but his scientific lectures left a permanent mark on his age. Sir John Lubbock, so wise in ant and bee lore, is a London banker. Botany readily lends itself to the investigations of an amateur and abundantly repays such attention.

The first requisite in a course of botanical study is a teacher who loves plants and has been admitted to their secrets through years of companionship. So essential does this seem to me that I would rather the students should have such a teacher and a barren city yard for a laboratory than a botanic garden with a teacher who has had only a formal introduction to his subject.

With a teacher who has a sympathetic love for plants any method chosen will be more or less successful, and I should hope he might be allowed to choose the lines of work as his own developed tastes might suggest. The lines open to him are many, and any one of them is available for his purpose. It may be that the phase of the subject which most appeals to him is the biology of plants, their habits of growth, and the means by which they contend in the struggle for existence. Horticulture may interest him most, or the artistic side of plant life. It is sure he will teach best the things he loves best, and the freedom a teacher must feel in using his own standards instead of those of an examining board should be utilized to give the study an atmosphere of breadth and culture.

The location of the school must often limit very much the ease with which the teacher may choose his illustrative material, and makes the courses pursued in the city and in the country differ very considerably, though the aim and end is the same in both. In general, the most familiar things should be those first studied. The school-yard flora and the trees passed every day should be made effectual in making the students interested and acquainted with things nearest to them.

Whatever is done should be done with the plants themselves, and, if possible, growing plants should be used. Out-of-door studies are most important. I know a school in a large city in Switzerland where the teacher holds at least one school session a week out of doors throughout the year. In the country, of course, such walks are easier to plan for and material is more abundant. Goldenrods make an attractive study for a fall lesson in the country. After the gathering of the many available kinds, they should be observed and talked about, then sketched and painted, if possible, and described in good, simple English. I met a little company of children happily gathering rose-leaves one day this autumn. They were to be carried to school to be painted. Crayoning will answer very well where paints can not be had. Nutting parties are very instructive, and, later on, walks may be made through the snow after the fruits of the birch and the winged seeds of the cones, and treasures gathered from the cups of the blue-curls and the seed store of the yarrow and other wayside weeds.

Potted plants can be grown in the school room. These should be free bloomers, and hardy, such as the nasturtiums and oxalis, scarlet geraniums and the cheerful little heartsease. Morning-glories, buckwheat and scarlet runners will grow up and blossom from the seed in a window garden. Small plants are desirable, so that they may be freely handled and watched at the student's desk. When cared for by the children their needs and habits will be learned experimentally, and can be made the subject of talks and written themes.

The students could carry small plants home with them to be cared for over Sunday. For water plants, a small flat-sided jar makes an excellent aquarium and a never-failing source of pleasure.

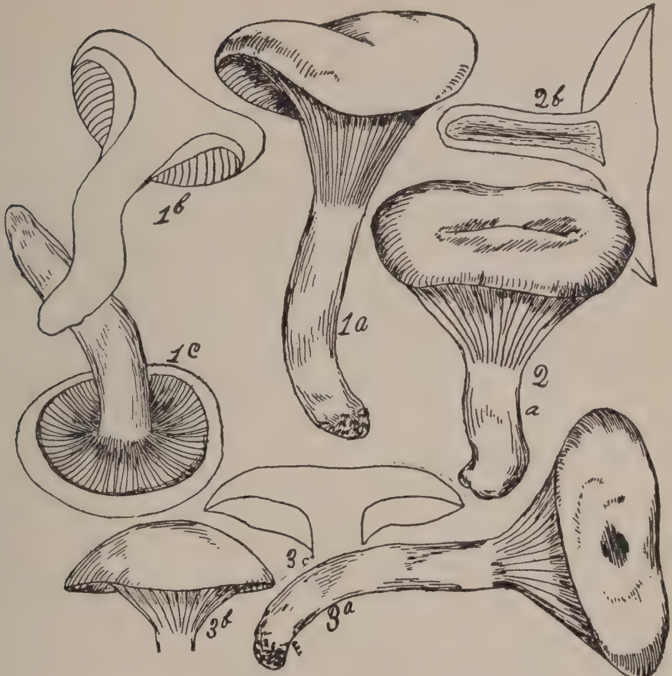
By no means should the study be aimless and diffuse in itself, but with the simplest accessible materials the peculiarities of growth and development can be studied in such a way as to make the student feel that the plant world is a living, pulsating reality, with which he may come to be in touch.

I know a little five-year old who defines wild flowers as those "that just belong to God and us," and since we must all walk "with feet to the earth," let us teach our boys and girls to feel that the earth is indeed our heritage, and that it is a goodly one.

Three Edible Species of Hygrophorus.

E. M. WILLIAMS.

During the second week of December a correspondent from Montgomery Co., Md., sent in specimens of the yellow-gilled Hygrophorus (*H. hypothejus* Fr.) and one that for want of a better common name may be called the Squirrel Hygrophorus (*H. sordidus* Peck), saying that he had frequently eaten them and found them excellent. In the Forty-ninth Report of the N. Y. Mu-



seum, Professor Peck recommends as edible the sooty Hygrophorus (*H. fuligineus* Peck). In the January number of *Rhodora* Mr. H. Webster gives *H. flavodiscus* as edible. This makes at least four common species of this genus that are edible. The fact that they are all late species coming in November, December, and even as late in some seasons as the early part of February, when most other species have succumbed to the cold, gives them added interest.

The three species have a similar habitat—barren pine woods. The sooty Hygrophorus and the yellow-gilled Hygrophorus often grow together, and seem to prefer young pines. The Squirrel Hygrophorus (Fig. 1) may be oftener found in older groves, and not alone those of pine. It is less known than the others, having been described only last year from specimens collected at Takoma Park. It seems quite abundant in this locality, and will doubtless be found elsewhere. It is quite a fleshy mushroom, with the edges much incurved and very rounded at first. It has a slight veil which generally soon disappears. As the mushroom expands it becomes flattened till it is almost or quite plane. It is slightly viscid, and is often soiled with adhering dirt, from which fact it derives its name *sordidus*. It is by no means sordid in color, however, for the cap is of such a shiny whiteness, even in spite of the dirt, that it can be recognized at a considerable distance. When it grows among leaves, especially after a rain, it has a very attractive appearance. Last year while walking through Rock Creek Park at a time when fungi abounded, great numbers of this fungus were found pulled up and with the gills eaten away—these gills are either pure white or of a delicate creamy tint, not closely crowded, and more or less decurrent. Other fungi growing near were untouched, even *Hygrophorus borealis* Pk., which resembles it in many ways and which grew everywhere abundantly, was passed over. There was every reason to believe this to be the work of squirrels, and so this fungus is given the name of Squirrel Hygrophorus. Their preference for it at a time when nuts were abundant would seem a very good recommendation for its use on the table.

The other two species mentioned are much more common, and so much alike that it requires close examination to tell them apart.

The yellow-gilled Hygrophorus (Fig.2) is most common here, and while there seems to be no mention of it as an edible mushroom in this country, it is classed in popular French books as "edible, but of inferior quality." Since it is to be found in such quantity almost all winter it should not be despised, and might be used for catsup if nothing else. The very glutinous coating which covers the entire plant when young, and is by no means easy to remove from the mature plants, is probably more in the way of its popularity than anything else. The cap is convex or nearly plane, of a gray-brown or yellow-brown color, considerably darker toward the center. The stem is stuffed, becoming hollow, and, though whitish at first, soon turns to a more or less deep shade of yellow. The gills are conspicuously decurrent, whitish or pallid at first, becoming flesh-color, yellow, or even a salmon-orange. The sooty Hygrophorus (Fig. 3) is generally of a darker color above, with more black or gray than the preceding. It never has an umbo. The gills are adnate or only slightly decurrent, pure white. The stem is solid, white, and even, though it varies much in length and size, and is often crooked on account of the plant growing in bunches. Professor Peck says that when the sticky covering and dirt are carefully removed the flesh is tender and of fine flavor.

We would be glad to receive notes on the edible qualities of this group of fungi from our correspondents.

Mycological Notes.

The January number of the Bulletin of the Torrey Botanical Club contains a brief report of "The Trenton Goldbach Poison Case," by Dr. Halstead. The Washington Mycological Club recently listened to a full report of the case from Mr. V. K. Chesnut, who visited the place and identified the cause of the trouble as the deadly Amanita (*A. phalloides* Fr.). Such tragedies serve more and more to emphasize the necessity of every one—man, woman, or child—becoming familiar with the appearance and nature of at least the two most dangerous Amanitas. This knowledge in one instance was probably the means of saving an entire family from being poisoned. The husband and wife were met on their way home with a basketful of mushrooms, largely composed of these two poisonous sorts. The people were with great difficulty induced to throw them away, saying "they look so nice and fresh they can not be dangerous."

The U. S. Department of Agriculture has recently published as Farmers Bulletin No. 86 an article on "Thirty Poisonous Plants," which may be had for the asking. The author has given excellent figures of these two poisonous Amanitas, together with full descriptions of the plants and the nature and effect of the poisons. The bulletin should be in the possession of every family in the country, and its contents familiarized by all.

Volume X, No. 4, of Experiment Station Record contains two interesting accounts of experiments to determine the food value of mushrooms. In summing up the first, the remark is made, "as dietic accessories the edible fungi may play an important part, but investigation has demonstrated that they can not be ranked with the essential foods." In regard to the second experiment the translator says: "The author compares mushrooms with other food materials and believes that some of the earlier investigators have underestimated their food value." Let the good work go on, but in the meantime we will eat our mushrooms —when we can get them—cheered by the thought that they are still classed as foods, and are acceptable to the palate, however much or little nutriment they may contain.

E. M. W.

Editorial.

In the present volume of the *Bulletin* it is intended to devote particular attention to two lines of work which our experience and consultation with other botanists have led us to believe are much needed, and will be appreciated. One is the presentation of live, suggestive articles on the best ways of studying and teaching, designed especially for the amateur and the teacher in the secondary schools. These articles will be prepared by eminent and experienced teachers and specialists. There has been great progress in methods of teaching natural science during recent years, but unfortunately it has not extended to the secondary schools to so great an extent as could be wished. It is our aim to bring as many teachers of botany as possible into touch with the latest and best methods of teaching this science through articles by leading botanists, written in plain, untechnical language. Dr. MacDougal's series of papers is being much appreciated, as are those on the lichens and fungi. In this number Mr. Pieters begins a series on the fresh water algae. Similar articles on other groups are being arranged for.

Another line to which we shall devote special attention is designed to meet the needs of a constantly growing company of plant lovers; namely, the members of the various mycological clubs, and others particularly interested in the higher fungi. Within the past few years there has been a very rapidly growing interest in these plants, as evidenced by the recent organization of flourishing mycological clubs in various parts of the country. We hope to aid and encourage this movement, and bespeak the support of those interested. You can help us by subscribing for the *Bulletin*, by showing it to your friends and getting them to subscribe, by sending the editors notes, sketches and photographs relating to subjects of interest to our readers, by writing good live articles on how and what to teach, how to study, or giving the results of your study and observation on some plants or group of plants.

Recent Literature.

Bulletin No. 29, by J. W. Toumey, of the Arizona Experiment Station, entitled "The Date Palm," will be of interest to many of our readers. An account is given of the introduction of this plant into the United States, where it has heretofore been grown chiefly as an ornamental plant. The bulk of the Bulletin is devoted to an account of the experiments made in Arizona in growing the palm for the fruit. It contains many interesting notes and illustrations regarding the plant.

C. L. S.

The "Bulletin from the Laboratories of Natural History of the State University of Iowa," Vol. IV., No. 4, has just been received. It contains two botanical papers. I. The Iowa Sedges, by R. I. Cratty, gives a list of the species thus far collected in Iowa with notes on their habits and distribution within the State. It is accompanied by ten plates illustrating as many species. II. Descriptions of American Uredineae II, by J. C. Arthur and E. W. D. Holway. The paper is intended to accompany the second fascicle of their Uredineae Exsiccatae et Icones. It contains descriptions and illustrations of the species issued, 29 in number, and all growing on grasses. The Bulletin can be obtained from the University, Iowa City, Iowa, for 50 cents.

C. L. S.

In a recent bulletin (No. 74) from the Indiana Experiment Station, Dr. J. C. Arthur gives an interesting account of the successful cultivation of the Starry Grass-wort (*Cerastium arvense oblongifolium*) as a bedding plant. Dr. Arthur's experiment shows how a comparatively insignificant native plant may with care and cultivation be made to surpass in beauty many of the standard cultivated sorts. It seems strange that so little attention is given by most people to the improvement of our native flowers and shrubs. Large sums of money are often spent in the endeavor to grow tender exotics, while much more satisfaction could frequently be gotten from plants of our own woods and meadows. Wild flower gardens can be made to add much to the attractiveness of the school yard, and at the same time furnish the children with a never-failing source of amusement and profitable study. With a little tact and encouragement on the part of the teacher the boys and girls can be induced to plant and care for such gardens, and will take a pride in the schoolhouse and grounds hardly possible otherwise. These gardens can be made particularly valuable to the rural school, where it is certainly of extreme importance that the pupils should learn to know plants and their habits and needs, but where all too often plants are seldom mentioned, much less studied or discussed in an attractive way.

Among the many botanical works that have appeared during the last five years designed more particularly for the secondary schools, that by Professor Atkinson* of Cornell University is one of the best. Throughout it is permeated with the breath of the field, meadow and brookside, and the teacher who can not with such a book as a text make his pupils feel that botany is an intensely interesting study, more than the mere "analysis of a few plants and the memorizing of a lot of long names" has certainly missed his calling. Although all may not agree with Professor Atkinson in the sequence in which the various subjects should be presented, all must agree that he has presented them in a very attractive manner, which after all is of greater importance. It is most refreshing to have a text book replete with new illustrations, so many of them literally breathing the air of the fields and filling one with a desire to be out among the very plants treated in the pages of the text. The author has spared no pains to bring the subject matter up to date, and has succeeded very well, indeed. There are a few slips, but these are easily corrected, and do not detract from the usefulness of the book. The publishers have done their part well, and all in all the book is a great success, and will undoubtedly do more than any other recently published work of similar scope to give the study of botany its rightful place as one of the most pleasant, as well as useful and ennobling, for young and old alike.

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*Elementary Botany, by George Francis Atkinson, Ph. B. Publishers, Henry Holt & Co., New York.

As much can scarcely be said of Dr. A. Schneider's* latest work on the Lichens. The first part of the work is mainly from the author's "Text book of Lichenology" and deals with such subjects as "The History of Linchenology," "Uses of Lichens," "What are Lichens?" "Morphology and Physiology," "Occurrence and Distribution," etc. Here the author has gathered together a great deal of valuable information, and this is by far the most useful part of the work. In his treatment of the "systematic study of Lichens" he is hardly consistent. Although we are told in the preface that "advance work" and "new discoveries" have no place in such a work as this, the author describes at least one new species, and makes various changes in names. The attempt to popularize descriptions is not very successful, apparently through insufficient knowledge of the plants themselves, possibly due to the lack of material from which to draw good characterizations. The work is marred by numerous typographical errors, and after reading it through one puts it down with a feeling of disappointment that with such a laudable object it should be so unsatisfactory. T. A. W.

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*A Guide to the Study of Lichens, by Albert Schneider, M. D., Ph. D. Publishers, Bradlee Whidden, Boston, $2.50 net.

News and Notes.

The second annual meeting of the Society of Plant Morphology and Physiology was held December 27 to 30, inclusive, at Columbia University, New York City. Over twenty papers were read, covering a wide range of subjects. Among those of special interest to teachers was one by Dr. W. F. Ganong, of Smith's College, on "Some appliances for the study of Plant Physiology." Dr. Ganong exhibited and described several pieces of apparatus for illustrating physiological phenomena which, though comparatively inexpensive, are sufficiently accurate and within the means of most high schools. The superiority of sphagnum moss for use in germinating seeds was spoken of. Dr. E. A. Burt, of Middlebury College, Vt., read an interesting paper on "The formation and structure of the dissepiment in Porothelium." Porothelium is a genus of the Polyporei, superficially resembling Poria, but producing papillae on the surface at first, these afterwards forming shallow pores. Dr. Burt's paper was illustrated by specimens and slides showing the development of the pores, which he finds are formed by a more rapid growth at the circumference of the papilla instead of a hollow tube opening at the summit. The attendance was good and the meeting a successful one, showing the great interest taken in morphological and physiological lines by the botanists of the country.

The Chicago Mycological Society was organized in December, with the following as officers: President, H. S. Pepoon; Vice-President, Prof. L. M. Umbach; Recorder, W. S. Bates; Treasurer, Grant Wyrick; Secretary, W. S. Moffatt. This adds another to the growing list of organizations whose object is the gaining and dissemination of a better knowledge of our fungus flora. We welcome this new member and wish it success.

Let me add one to the list of Albino plants. Last summer in Jefferson, N. H., in a large field where there were hundreds of specimens of *Habenaria fimbriata*, I found one plant on which every blossom was the purest white.

I wish to inquire through the *Bulletin*, if any one can give information regarding the artificial fertilization of the *Akebia quinata*. So far as I can learn, it is never fertilized naturally in New England. I have made very many attempts, but with absolutely no success.

Emily H. Terry.

To the Gray Memorial Botanical Chapter of the Agassiz Association. The *Bulletin* welcomes you to the use of its columns for chapter notices and will be glad to publish such papers as come within its scope.

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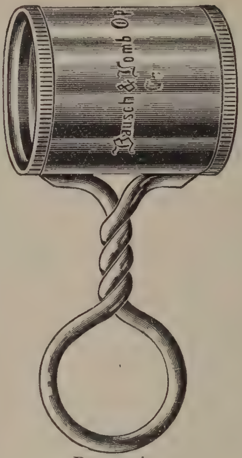

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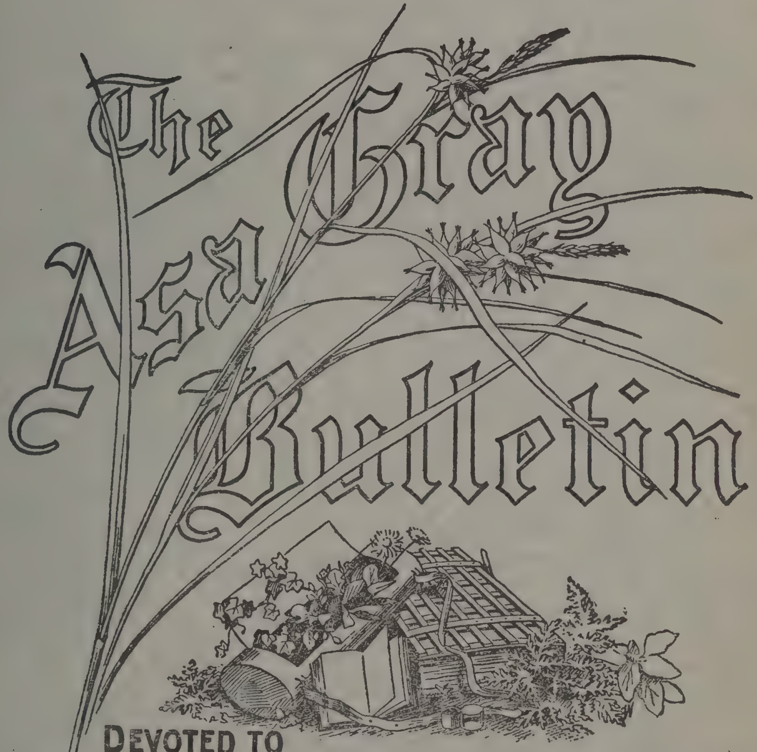

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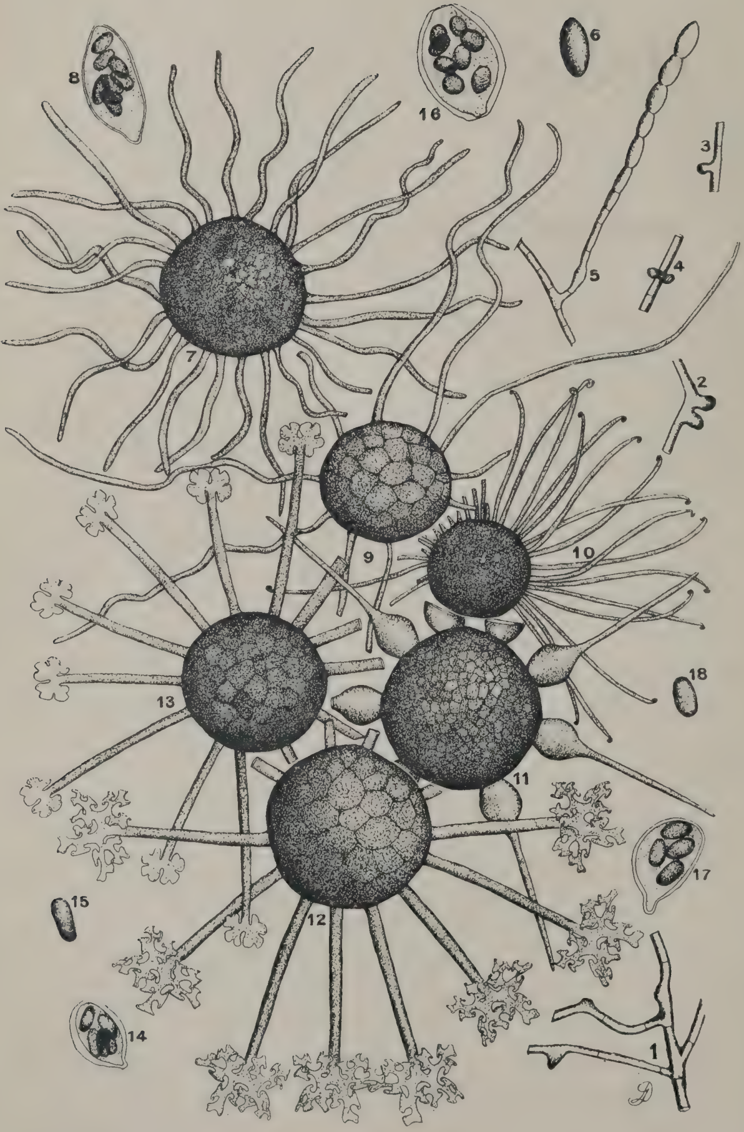

THE BLIGHTS, OR POWDERY MILDEWS.

Asa Gray Bulletin.

VOL. VII. NO. 2. APRIL, 1899. Whole No. 30.

The Blights, or Powdery Mildews.—Plate III.

DAVID GRIFFITHS.

We all have pleasant memories of berry picking, and the most casual observer has noticed that frequently some of the gooseberries have rusty colored spots upon them. Often, too, the leaves and young shoots become shriveled and dull-rusty in appearance about the time that the fruit begins to ripen. Again, if we examine the leaves of the lilac during the late summer and early autumn months they will often be found to be covered over the upper surface with a thin white cobweb-like film. With a good hand lens one may generally find small brown or black bodies scattered about in this film. Early in the season these bodies may not be easily found, but plenty of them can be seen later. Similar observations on garden and field peas will often show a like growth on the leaves and shoots.

The "mildewed" appearance of the plants above mentioned is due to certain parasitic fungi belonging to the family *Erysiphiaceae.* The three briefly characterized above are known as gooseberry blight, lilac blight, and pea blight, respectively, and differ sufficiently in their botanical characters to belong to different genera. Careful examination of the leaves of other flowering plants will show that many of them are attacked by these blights or mildews. This is the case with willow, oak, grape, dogwood, elm, catalpa, skullcap and many other common plants.

It is an easy matter to preserve these fungi for study. The leaves and other affected parts of the host plants may be collected and dried between sheets of blotting paper, as is done in preparing herbarium specimens of flowering plants. Care should be taken to collect newly attacked leaves as well as those on which the fungus has reached an advanced stage of development, and it is a good plan to collect at different times from the same host plant. Thus a series of specimens of lilac blight collected in July, August and September will be much more valuable for showing the different stages in the development of the fungus than the specimens of a single collection. The specimens should always be accompanied by a slip of paper containing a record of the date and locality of collection, together with the name of the plant upon which the fungus was growing.

For the proper study of these fungi a compound microscope and accessories, such as was described on page 77 of the *Bulletin* for October, 1898, is necessary. One needs also a 5 or 10 per cent solution of caustic potash and a little diluted alcohol.

The literature dealing with the Powdery mildews is found mainly in general works on fungi, such as Saccardo's "Sylloge Fungorum" and "North American Pyrenomycetes," by Ellis and Everhart. Dr. Burrill's pamphlet on the Illinois species, published as a part of the series on the "Parasitic Fungi of Illinois" and a similar pamphlet by Dr. Bessey, dealing with Iowa species, will be found very serviceable in the systematic study of these plants as will also Dr. F. D. Kelsey's paper on "Uncinula." Dr. R. A. Harper, of the University of Wisconsin, has published an excellent paper on the life history of certain species.

With a goodly quantity of material collected during the season one can spend many pleasant winter evenings in the systematic study of it. In taking up any line of study in natural history it is necessary for the student to have some instruction regarding what he is to do and see, that he may not waste valuable time in desultory work. While it is a grave error to do for a student what he may do himself, it is a graver one to "throw him on his own resources" when he possesses none. Acting on this principle some specific directions for the study of the *Erysiphiaceae* are given—suggestions that will lead to the discovery of certain important characters upon which the classification of the group is based.

A portion of a pea leaf which is affected with the Powdery mildew and which was collected early in the season is soaked in 5 to 10 per cent solution of caustic potash for fifteen or twenty minutes and then washed to remove the potash. The thin mycelial film can now be easily removed from the leaf by scraping lightly in one spot and then stripping off the whole with the scalpel and thumb or with a pair of forceps. This film of mycelia is now mounted right side up in a drop of water, care being taken to straighten out all folds that may occur in transferring the film from the leaf. It is best to examine with a low power first. After getting a general survey of the field we are ready to examine more closely and minutely.

At first (if the material was collected early according to directions) nothing but a mass of interwoven mycelium (Fig. 1) is seen. Are these threads of uniform diameter, or are they expanded into haustoria (Figs. 2-4) in certain places? During the life of our plant these haustoria adhered closely to the surface of the leaf, and served not only to hold the fungus fast, but also to furnish it with food already prepared by the pea plant on which it lived. Our object in soaking the leaf in caustic potash was to loosen these haustoria by softening the wall of the leaf cells. We should next look for erect conidia-bearing hyphae (Fig. 5) growing from the horizontal mycelium. Observe that the conidia are cut off, one at a time, from the top of the hypha by a deepening of the constrictions which already mark off several spores, each of which is at present successively smaller than the one above it. Many of these spores (Fig.6) may be found loose in the field of the microscope.

Another mount should now be prepared in the same way as before, from material collected later in the season. Usually, however, all that is necessary is to scrape the surface of a mildewed spot on the leaf and mount in a drop of dilute alcohol to remove the air, and then apply a little caustic potash solution to swell the tissues of the fungus to their original dimensions. Observe now the black specks (Perithecia, Fig. 7), which were seen with the hand lens when the material was collected. It will be noticed that the perithecium has a cellular appearance, and if the cells are compared with those of the perithecia of other blights in will be found that the size of the cells varies considerably, especially between the different genera. This comparison of the perithecia will also show that there is more or less difference in size between the various kinds.

A close examination will show that the perithecium is provided with slender appendages, which have much of the appearance of the threads of the mycelium, but may usually be distinguished by a difference in color and other minor differences. Some of the most important generic characters are based upon these appendages, hence it is very important that they be carefully studied. In the species in hand they are unbranched, but in those belonging to the genera *Microsphaera* and *Podosphaera* they are branched, while in *Uncinula* the free ends are hooked, and in *Phyllactinia* the base is bulbous. With a little practice one can learn to tap the cover glass with a pencil or the handle of a scalpel sufficiently to rupture the perithecia and observe the mount under the microscope at the same time. As the perithecia begin to rupture small colorless bodies will be seen to escape. When these are examined with the higher power they will be easily recognized as the asci (Fig. 8). These contain spores. It is quite necessary to determine the number of spores in each ascus, and also the number of asci in each perithecium.

The above suggestions will serve as a guide for the study of all the specimens of this family, which may have been collected. Keeping these suggestions in mind while examining the mildews found on lilac, plum, gooseberry, willow, oak, in addition to that on the pea already studied, and tabulating the results, one can get a clear idea of the characters upon which the classification of the *Erysiphiaceae* is based. Experience will teach us that the species are confined to certain host plants. It is true that the same species is in many cases found on several hosts, and one can never be certain in any determination of species without careful microscopic examination. Nevertheless, if we have our host plants carefully named we will find it a great aid in determining the species of our fungi. On the plants named above one will usually find definite species of blight, and these will belong to different genera. Assuming that we have studied the common mildew of each of these hosts for two of their characteristics (character of the appendages and the number of asci in a perithecium they may be tabulated as follows :

NAME OF FUNGUS.	APPENDAGES.	NUMBER OF ASCI.
Pea Mildew (*Erysiphe Communis*)	Similar to Mycelium	Several in each Perithecium
Gooseberry Mildew (*Sphaerotheca Mors-urae*)	Similar to Mycelium	One in each Perithecium
Willow Mildew (*Uncinula Salicis*)	Coiled at Tips	Several in each Perithecium
Oak Mildew (*Phyllactinia Suffulta*)	Swollen at Base	Several in each Perithecium
Lilac Mildew (*Microsphaera Alni*)	Tips Branched	Several in each Perithecium
Plum Mildew (*Podosphaera Oxycanthae*)	Tips Branched	One in each Perithecium

Comparing these results it will readily be seen that the above mildews may be separated into two groups, one with simple thread-like appendages, the other with swollen, coiled or branched appendages. These two groups may each be further subdivided according to the number of asci in the perithecium. Carrying the subdivision still further the following "key" or synopsis results, and will be found useful in determining the genus to which a given specimen of any of our common mildews belongs:

A. Appendages similar to mycelium (except possibly in color).
   1. Perithecium containing one ascus—I Sphaerotheca (Fig. 9).
   2. Perithecium containing several asci—II Erysiphe (Fig. 7).

B. Appendages differing from mycelium.
  1. Appendages coiled at tips—III Uncinula (Fig. 10).
  2. Appendages swollen at base—IV Phyllactinia (Fig. 11).
  3. Appendages branched at tips.
    a. Perithecium containing several asci—V Microsphaera (Fig. 12).
    b. Perithecium containing one ascus—VI Podosphaera (Fig. 13).

Explanation to Plate.—Fig. 1, Mycelium of *Erysiphe graminis* DC.; Figs. 2, 3 and 4, Haustoria of same; Figs. 5 and 6, Conidiophore and Conidial Spore of same; Figs. 7 and 8, Perithecium of *E. graminis* and Ascus from same; Figs. 9 and 16, Perithecium and Ascus of *Sphærotheca castagnei* Lev.; Figs. 10, 17 and 18, Perithecium, Ascus and Ascospores of *Uncinula salicis* (DC.) Winter; Fig. 11, Perithecium of *Phyllactinia suffulta* (Reb.) Sacc.; Figs. 12, 14 and 15, Perithecium, Ascus and Ascospore of *Microsphæra alni* (DC.) Wint.; Fig. 13, Perithecium of *Podosphæra oxycanthae* (DC.) DeB.

Figs. 7, 10 and 11 show a magnification of about 170; Figs. 6, 12, 13, 15 and 18 a magnification of about 480; and the remainder a magnification of about 340.

Studies in Plant Physiology.--III.

The Kinds of Work Carried on by Plants, and the Manner in Which it is Divided Among the Different Members.

DR. D. T. MACDOUGAL.

The Roots—Continued.

EXPERIMENT IX.—The food substances which the plant obtains from the soil are derived from the small bits of rock which are plentifully scattered through it, and from the decaying twigs, leaves, stems, and other "dead" matter. The decay and decomposition of the "dead" materials results largely from the activity of bacteria and other minute organisms in the soil, which are invisible to the naked eye. The "microbes" break down this material in order to obtain their own food, and in so doing manufacture certain substances of very great value to the higher plant. Carbonic acid is formed constantly in the soil, and it etches or dissolves the rocks. The mineral substances of the rock can be absorbed by the root-hairs after they have been dissolved in this manner. In many instances the walls of the root-hairs are saturated with a corrosive liquid which will also dissolve rocks, with which they come into contact. To demonstrate this action, fill a small flower-pot half full of common garden soil, and on top of this lay a piece of polished marble, or an oyster shell with the hollow, or polished surface uppermost. Cover with three inches of clean sand. Place one or two beans in the sand, and water from day to day. After a few days the seeds germinate and send roots down through the sand against the marble or oyster shell. Remove the marble or shell two weeks later, wash clean and wipe dry. Hold between the eye and the window in such manner that the surface will be seen by sharp reflected light. Irregular branching lines, or roughened areas will show where the roots have touched the mineral and removed some of it.

EXPERIMENT X.—If you were to place some water from the soil on one surface of a piece of parchment, and a like amount of the liquid containing sugar on the opposite side you might see that the sugar solution, soon draws the soil water through the parchment. It is by a similar action that root-hairs take water from the soil. The root-hair has the shape of a finger of a glove with its walls made of parchment. It is lined with living matter and is filled with water containing sugar and acids. When it touches the thin coat of water on the bits of rock in the soil, the water is drawn through into its cavity in the same manner as through the parchment. Beside this attractive power of the solution inside of the hair, the thin layer of living matter lining the wall is of such nature that it will allow the mineral solutions from the soil to pass in through it, but will not allow any quantity of the sugar to escape. You may imitate the action of the root-hairs by the following methods. Cut away the top of a carrot, and dig out a cavity as large as an acorn. Fill the cavity with fine sugar and set aside for a few hours. The sugar is converted into syrup, having drawn water through the walls of the cells of the carrot. The action of the root-hair is demonstrated still better by the following demonstration. Select a long, sound potato, and bore a cavity in it reaching from one end nearly to the other, being careful not to split it. Trim the skin from the closed end and shape it to stand upright. Set the prepared potato in a saucer containing an inch of water, fill the cavity of the potato with sugar. Examine five or six hours later. The sugar inside the potato will have drawn water from the saucer through the walls and filled the cavity in an exact imitation of the action of the root-hair. The potato may also be pared into regular form, as in the accompanying diagram.

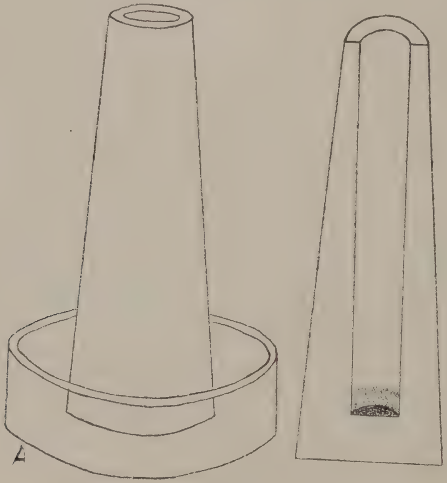

Figure 3.—A. Potato with central cavity, containing sugar standing in saucer filled with water; B. Section of potato, showing the cavity only partly filled with sugar.

EXPERIMENT XI.—The substances which the plant uses for food are not to be found everywhere, but occur in suitable quantity only in certain places in the soil. The root will be of the greatest use to the plant when it can find the food as well as absorb it when found. The root is capable of finding food or directing its growth toward portions of the soil which contain it. It does this by a sensitiveness to certain forces, such as gravity, light, heat, moisture, chemical substances, etc. You may see one form of sensitiveness if you will germinate a pea or bean, and when the seedling has formed a root two inches in length, thrust a pin through the seed and fasten it to a chip or piece of cork, with the tip of the root pointing upward. Float the cork in a saucer of water and cover with a tumbler. Two hours later the tip of the root will be curved and will point downward. This is due to its sensitiveness to gravity. The root tends to place its axis in such manner that the tip will point toward the center of the earth, entirely independently of its weight, which is not sufficient to cause it to curve in this manner. The downward growth of the first roots of the seedling, in order to penetrate the soil, is a necessity with almost all plants. After the main root has bored down into the soil, the substances it must absorb are scattered in all directions from it. To meet this state of affairs, the branches of the main root tend to lie nearly horizontally, thus radiating from the primary roots. The main or primary root itself may now encounter other forces which will cause it to bend away from the perpendicular. The action of moisture on the root may be demonstrated in the following experiment.

EXPERIMENT XII.—Place some germinating peas in a deep cigar box full of garden soil. They should be planted in the ordinary manner, near the middle of the box. Give the seedlings the necessary amount of water every day by pouring it on the soil at one end of the box. Two weeks later turn the box upside down, allowing the soil to come out in a mass. Carefully follow the roots and note whether they have turned toward the moist or dry end of the box. This sensitiveness of roots to moisture, by which they are attracted toward it, causes cisterns and drains to become filled with the roots of trees, clover, grasses and other plants.

EXPERIMENT XIII.—Tie a piece of muslin over the top of a tumbler and punch a number of holes in it with a bodkin. Fill the tumbler with water. Lay some germinating radish seeds on the muslin and fill the tumbler with water, and keep it full enough to moisten the cloth. Set in a window. Notice the position of the roots. In bending away from the light they follow the same form of sensitiveness as when they enter the soil.

EXPERIMENT XIV.—The tips of the roots are forced through the soil by the great pressure of growth. This is sufficient to cause them to penetrate comparatively hard and solid objects. If you should dig up the roots of a vigorous specimen of the couch grass you may be able to find that they have penetrated bits of wood, roots of other plants, or, if in a potato field, you may be so fortunate as to find one which has bored through a tuber. The tip is composed of extremely delicate tissue, which is easily crushed. To protect this, most roots are furnished with a cap, which is very much like the tip of a glove-finger. This sheathing cap may be seen on many plants with the naked eye. On the water hyacinth it forms a sheath nearly a fourth of an inch long, which may be pulled away and examined. Look for it on other aquatic and land plants.

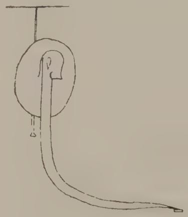

Figure 4.—Seedling of pea, with a bit of paper fastened to one side of the tip. The root has curved to one side in the effort to avoid it. (After Darwin.)

EXPERIMENT XV.—The root cap alone is not sufficient to prevent damage if the tip is pressed against a rough stone or sharp splinter. To enable it to escape such damage, the root is sensitive to touch of a hard object, or to an injury, bending away from the source of contact or injury. You may demonstrate this if you will repeat one of Darwin's classical experiments. Fix a seedling to a cork, as in Experiment 11, using a very long pin, and with the tip of the root pointing downward. Now cut the smallest bit of paper you can handle, and coat one surface with gum-arabic, softened with water. Attach to the tip of the root (See fig. 4). Observe four or five hours later, and a day later. The root will curve as it would in avoiding a stone or hard object in the soil.

Sensitive Stamens in the Genus Opuntia.

J. W. TOUMEY.

In recent years several observers have noted the marked sensitiveness of the stamens of various species of Opuntia. In most cases the observations have been confined to a few of the subgenus Platopuntia.

In the cactus garden at the University of Arizona nearly fifty species of Opuntia are growing without winter protection, and bloom and fruit as freely as in their uncultivated state. This list is too long to enumerate here, but without exception the stamens of all are more or less sensitive to external stimuli induced by contact with insects or other objects. The region representing the source of movement is at the lower portion of the filament, the filament being larger in this region than elsewhere, and generally tapering toward the anther. An object coming in contact with the anther or upper portion of the filament, be the contact ever so slight, will cause the sensitive region of the filament below to respond and the stamen will bend forward with considerable rapidity bringing it in contact with the style a half inch or less below the stigma. I believe it to be universal in this genus that the stamens are shorter than the style, so that when they are bent forward under the action of stimuli they never come in contact with the stigma, but closely encircle the style below. This condition, as will be seen later, is a provision for cross fertilization.

The flowers are mostly visited by bees, although a number of species of Coleoptera, mostly small species of Carpophilus and Notoxus, are nearly always found on cactus flowers. A number of other insects are occasional visitors. To bees, however, is the responsibility of cross fertilization almost entirely entrusted. When the flower opens with stamens extended, as in the partially diagramatic Fig. C, bees readily pass between the style and stamens to the open space at the base of the style. In all the flowers of the genus there is more or less space between the base of the style and the origin of the innermost stamens. Several bees are frequently found in a single flower, as may be observed in specimens of *Opuntia engelmanni*, *O. chlorotica*, *O. macrocentra*, *O. spinosior*, *O. ehinocarpa*, and many other species.

As the bee enters the flower, the stamens on the side from which it enters immediately bend forward, bringing the anthers in contact with the style, as in Fig. D. Other bees may enter from the other sides, or a single bee, by moving around the style in the open space at its base, may cause all the stamens, which are not infrequently several hundred in number, to bend forward to the style, forming an arched roof, as it were, imprisoning the insect or insects.

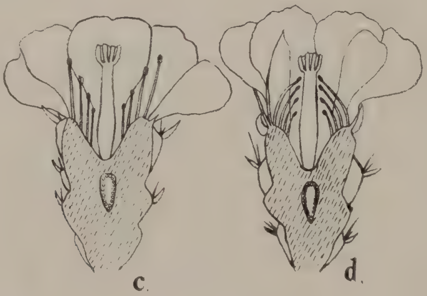

Figure 1.—Sections of two flowers of Optuntia. C. Stamens in normal position; D. Stamens bending towards the style in response to stimulus.

Not infrequently the tension of the stamens is so great that insects as large as honey bees are unable to escape for some time. It seems that when bees are imprisoned in this way for a time, the continued stimuli, i. e., the motion of the insect within the flower, does not induce in the stamens a continued tension as great as at first. However, I have examined flowers of many Opuntias between nine and ten o'clock at night, and in many instances have found from one to nine bees under the arch of stamens in a single flower. Whether it is a habit of bees to occasionally stay over night in flowers, or whether in this case they were forcibly detained by the flowers I am unable to say. An insect in leaving the flower must climb up the stout style, forcing its way between the style and stamens, the anther rubbing against it as it escapes. As it flies away it is fairly covered with pollen. The large stigma in the center of the flower is its usual resting place as it continues its visit from flower to flower.

Not only is the sensitive character of stamens to be observed in the genus noted, but it is well marked in Echinocerei, and to some extent in Echinocacti and Mamillaria.

Shorter Articles.

A White Form of Carduus Arvensis.

Had it not been for Dr. Gray's statement that "a white-flowered variation of any other colored blossom may always be expected," I should have been surprised on being conducted in July, 1897, to an area containing some two or three square rods covered with white-flowered *Carduus arvensis*, L. It was in a small clearing surrounded on the north, south and west by wooded land. The owner assured me that these plants, which gained a footing some years ago, but are cut each year before seed matures, have never before differed from the normal colored ones, an abundance of which are found on all sides. The plants range in height from one to eight feet. They are not pure white, but slightly tawny, with no tinge of purple, or pink. The dingy color deepens in drying. In the main collection of albinos I found but two plants of the normal color; also two or three of *C. lanceolatus*, L. There were several white plants scattered about in the adjacent growth of common *C. arvensis*. In no instances could I find the transition in progress. Each individual was clearly distinct and pure. The surrounding conditions were the same as in previous years, unless I except frequent and copious rains during the summer. Why, then, the change in color? And why was the abnormal color limited to a small portion of the ground infested by the plants?

Bessie L. Putnam.

Relative Rate of Growth of Peas and Beans.

Parallel rows of peas, "American Wonder," and bush beans, "Golden Wax," were sown upon June 20th. There was great difference in the time of the first appearing of the plants above ground. When the beans were so far up that the first pair of leaves were nearly fully developed there were no pea plants in sight. Upon July 5th the peas were breaking ground, and some of the plants were showing the small green leaves and the stems an inch or less above the earth's surface. At this time the beans had the first of the trifoliate leaves quite well developed, and the plants averaged about six inches in height.

While the pea and bean belong to the same family of plants (Papilionaceae) they are far from alike in the method of germination and the type of seedling that is produced. The pea retains its cotyledons below ground and first of all develops a very strong root. In the plants under consideration the descending main root was fully four inches long, while the distance from the cotyledons to the tip of the uppermost leaf was about two inches. Upon the other hand the bean has a much branched root system, and the tap root, while present, takes a secondary place. On the 15th day the absorbing root surface in the bean seedling was several times that in the pea. The ratio between root and leaf surface is about the same in the two kinds of plants; but the bean is far ahead of the pea at the end of a fortnight.

B. D. Halsted.

Recent Literature.

The February *Bulletin*, of the *Torrey Botanical Club*, contains a paper by Professor Peck, describing twenty new species of fungi. Among them we find one, *Agaricus argenteus*, from the vicinity of Washington, named by Mr. F. J. Braendle. It is a small mushroom, and said to be of excellent flavor. It has no doubt often been collected and eaten with *A. campestris* without being recognized as distinct.

Prof. C. G. Lloyd, of Cincinnati, has recently published another of his interesting series of pamphlets on fungi. It contains descriptions of four of the small Volvarias, the species of the genus Pluteus in the vicinity of Cincinnati, and other interesting items. The paper is made a little confusing by the omission of the authorities for the species. In the case of the species *Calvatia aurea*, the reader is in doubt as to whether the name is the author's or not. We hope the readers of this magazine who have benefited by Mr. Lloyd's generosity will make an effort to show their appreciation of his work by sending him specimens of the species he describes or others that they think would be of interest to him, especially when the species are found in unrecorded localities or have marked variations. E. M. W.

Seed Dispersal is the title of a very instructive little book of eighty-seven pages, by Dr. W. J. Beal.* It includes more than the title indicates, as it treats of all of the principal methods of plant dispersal; the propagation and movement by roots, rootstocks, bulbs and detached living branches as well as the numerous methods by which seeds are distributed. The subjects are treated in a suggestive rather than an exhaustive manner, as it is always Dr. Beal's aim to teach how to see rather than what to see. The charm of this book lies in the fact that the author has discovered for himself many of the adaptations for plant migration that he writes about, and he tells just enough to interest the reader and invites him to go and look for more. The book is well illustrated with text cuts. The style is such as to adapt it to the use of primary teachers who have charge of nature studies.

L. H. D.

All progressive teachers of botany who have not already seen Spalding's Introduction to Botany will find it worthy of their examination. It embodies all the fundamental principles of rational science teaching, and is adapted to the use of high schools especially. It justly presupposes a knowledge of the subject on the part of the teacher, and is, of course, not suited to the "cramming of facts" system too often prevailing in secondary schools.

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* Seed Dispersal, by W. J. Beal, M. S., Ph. D., Published by Ginn & Company, Boston, Mass

Boyer's Elementary Biology is another book adapted to the same grade of work, but including studies of both plant and animals. Both works are published by Messrs. D. C. Heath & Co., Boston, Mass.

C. L. S.

The Report of the State Botanist of New York for 1897 has recently reached us. It contains, as usual, a considerable number of descriptions of new species of fungi, largely Hymenomycetes. It is also accompanied by descriptions and plates of fifteen species of edible fungi, making a valuable addition to the many illustrations of edible species already published by Professor Peck. The additions to the State Herbarium which he reports are remarkable when the disadvantages under which he labors are taken into consideration. It is a great regret that the wealthy Empire State does not make better provision for its indefatigable botanist and the invaluable collection of fungi which he has made. The collection is largely inaccessible at present, and liable to damage. No satisfactory work in any group of our American fungi can be done without reference to the types which this great collection contains, and it is to be hoped that the State will make proper provision for the care and protection of it.

C. L. S.

The Trees of Wyoming and How to Know Them is the title of Bulletin No. 40, of the Wyoming Experiment Station. In it the author, Prof. Aven Nelson, has put in a popularized form an account of the trees found growing wild in Wyoming. There are numerous illustrations accompanying the text, which ought to be of much assistance to those for whom the publication is intended. There is great need of arousing an intelligent interest in tree planting and forest preservation, especially in those States in which it is so necessary to conserve the water supply.

C. L. S.

Jaczewski, Komarov and Tranzschel have just issued fascicles IV and V of their Fungi Rossiae Exsiccati. Among other interesting things it contains a collection from Manchooria, a region which is but little known botanically. A number of new species are included accompanied by descriptions. C. L. S.

Several publications have recently come to hand that are of special interest to teachers. Dr. W. J. Beal has issued two more of his helpful and suggestive "Bulletins in Elementary Science." In one of these (Bulletin 5) he tells about "Branches of Sugar Maple and Beech as seen in Winter," and in the other, "Potatoes, Ruta-Bagas and Onions," are taken as subjects for interesting talks. It is an encouraging sign to see the interest that is being taken in nature study by the authorities and teachers in many of our leading agricultural colleges and universities. How much more is being done to help the teachers in the public school than was done even ten years ago! Is there a teacher who can read Professor Bailey's "Hints on Rural School Grounds" (Bull. 160, Cornell Univ.) and not determine to do more in the future toward making his or her school room or school grounds more attractive, more in keeping with the idea there expressed as to what they should be? Who does not remember with greatest love that teacher who brightened the daily grind of the school room with fresh bits from nature's storehouse? How much brighter and fuller has the after life been through the companionship with nature resulting from this early teaching? Two other pamphlets from Cornell are just at hand, namely, "How the Plant gets its Food from the Soil" and "How the Plant gets its Food from the Air," both by B. M. Duggar. Although designed especially for a "farmer's reading course," these pamphlets will be found of much value to teachers, particularly those in the rural schools.

Dr. Charles E. Bessey has again laid teachers of botany under special obligations to him for his suggestions on "The Management of a Botanical Laboratory," published in the January number of the *Journal of Applied Microscopy.* Dr. Bessey speaks from the wide experience of a long and successful career as a teacher of the "new botany," and his words are full of valuable hints, especially for those just beginning courses in laboratory instruction. The writer knows by experience something of the stimulus and enthusiasm that come from working in the laboratory of a man who "likes to walk through the laboratory and hear the low talking of interested workers," where "each student works out his problem himself, aided by judicious suggestions," and where the student can "drop in for an extra hour or two of work when the spirit of botany moves him so to do." The "spirit of botany" is always there, and what is more, stays with the student through life, no matter what the future calling may be.

T. A. W.

News and Notes.

We would call the attention of our readers to the prizes offered by American Gardening for essays on hybridization. This is a subject of great interest and much practical importance, and anything which tends to stimulate interest in the matter should be encouraged.

Mr. M. A. Carlton has lately returned from Russia, where he has been investigating the various varieties of cereals for the U. S. Department of Agriculture. Seeds of plants likely to prove of value in this country were purchased for trial here.

Mr. Ernst Bessey, of the University of Nebraska, has recently been appointed to a position in the Division of Vegetable Pathology and Physiology, U. S. Department of Agriculture.

Dr. D. T. MacDougal has recently been appointed Director of the Laboratories of the New York Botanical Gardens. Dr. J. K. Small has been appointed curator of the Garden Herbarium, and Dr. M. A. Howe has succeeded him as curator of the Herbarium of Columbia University.

Mr. James A. Graves very kindly renews his offer to send specimens of sedges to subscribers of the *Asa Gray Bulletin*, who will send him 10 cents for the necessary postage. Mr. Graves is one of our most enthusiastic students of the sedges, and any of our readers who are interested in this group of plants will do well to correspond with him.

For several years Dr. John W. Harshberger has been engaged in preparing a history of "The Botanists of Philadelphia and Their Work." His material is now ready for the publisher, and will be sent in as soon as a sufficient number of copies have been sold to warrant the publication of the work. The book will contain about fifty illustrations of botanists, as well as of celebrated botanic gardens and places of botanical interest. "Many of our early botanists of historic importance were Philadelphians," and hence a history of them and their work deals largely with the development of the science in America. Biographies of 126 botanists are included, and also short accounts of nearly a hundred more. "The price of the book has been fixed at $4.50 (postage free)." Those ordering ten or more copies can procure the work at $4 per copy. Correspondence may be addressed to Dr. John W. Harshberger, 737 Corinthian avenue, Philadelphia.

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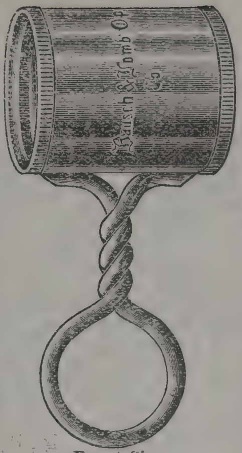

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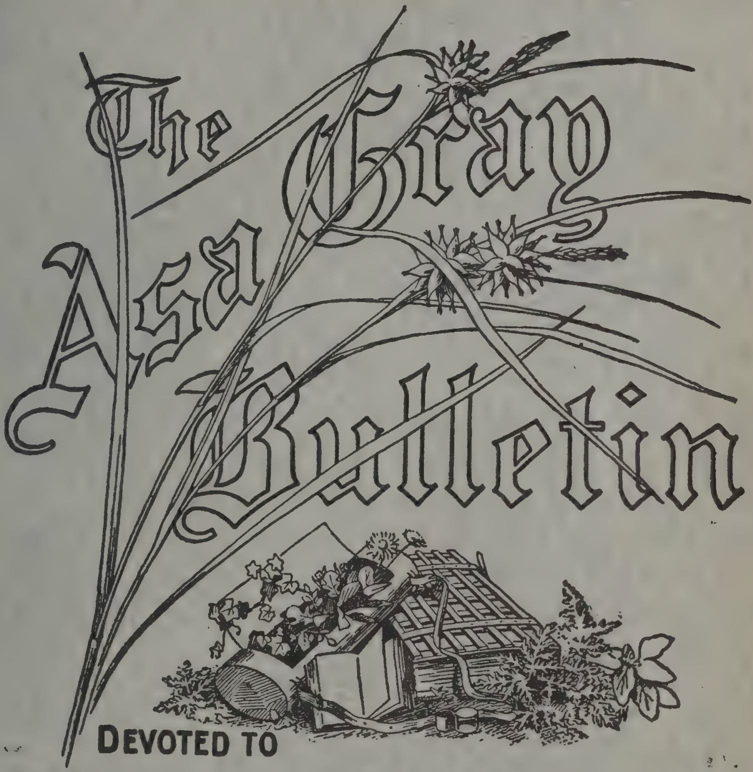

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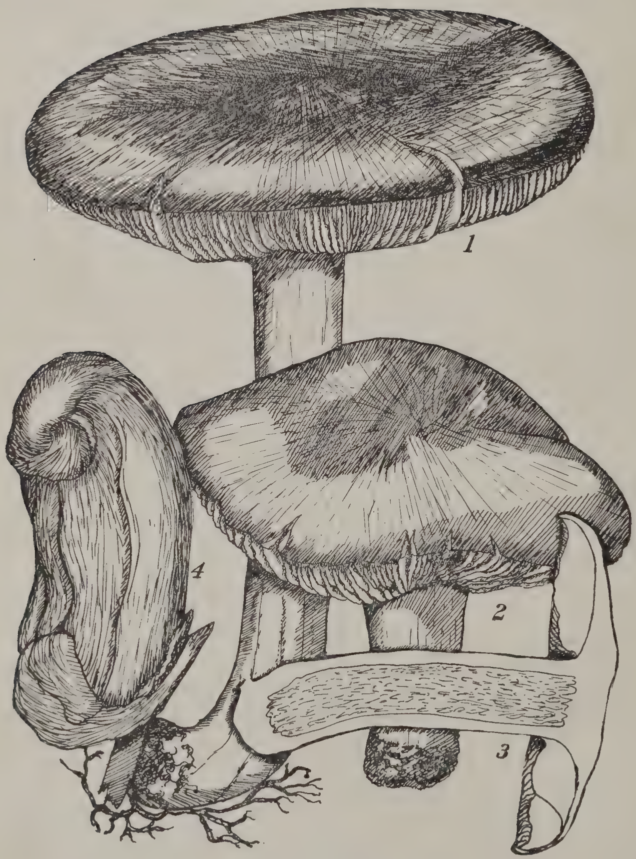

COLLYBIA PLATYPHYLLA.

Asa Gray Bulletin.

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The Broad-Gilled Collybia.—Plate IV.

E. M. WILLIAMS.

Among the larger agarics to be found in early spring, one of the largest and most striking is the Broad-gilled Collybia (*C. platyphylla*, Fr.)*

It is generally quite common and is especially characterized by its very broad gills, which are often an inch broad and are beautifully notched and ruffled. The pileus is from three to six inches or even more broad. It is a clean looking fungus when young and perfect, and may be found singly or in great clumps (sometimes as much as a bushel in a place) at the base of old stumps, and about old logs, in soil containing much rotting wood.

At a recent meeting of the Washington Mycological Club a specimen was exhibited measuring fully eight inches across the top, and with gills 1½ inches broad. It must have weighed fully half a pound.

Growing with the perfect plants are often to be found many abortive ones, some of them scarcely bearing any resemblance to the normal form of the species. Such an abortive specimen is shown in plate IV, fig. 3.

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*Collybia Platyphylla Fr.—Pileus fleshy, but thin and fragile, convex, becoming flattened, obtuse, moist in wet weather, more or less streaked with fibrils, commonly grayish-brown, but varying from whitish to dark brown, sometimes with the disk darker than the margin; lamellae broad, adnexed usually deeply emarginately or obliquely truncately notched next the stem, white; stem stout, fleshy, equal, striate or fibrillose-striate; stuffed or hollow, white or whitish, blunt at the base or praemorsely radicating; spores subglobose, broadly elliptical.—Peck. Report, N. Y. State Museum, **49**:35.

Prof. Peck, in his description of the species as it occurs in New York, says: "Occasionally a slight anise-like odor is perceptible, but in decay the plants have a very disagreeable odor and disgusting appearance. Insects are very fond of them and it is not uncommon to find the pileus dotted with their eggs." The plant certainly does its part to nourish the insect world, but it is still possible, early in the season, to find many perfect caps that are entirely free from insects and present a very attractive appearance. Two enthusiasts of our local club recently prepared and ate a dish of this fungus with no bad results. Contrary to what might have been expected from such coarse-looking mushrooms, they become quite tender when cooked but a short time, and have a very agreeable flavor. If others have tested the edible qualities of this fungus we would be glad to hear of their experience. If this mushroom should prove to be a good one for the table it would have considerable value, since it is very abundant, often as early as the middle of May. It is easily cleansed and prepared for cooking on account of its clean habits of growth and large size.

Most of the Collybias are so thin and tough that they are not generally regarded as edible. It is not known that there are any dangerous species in the genus. Several of the species are very abundant, and two of the common ones, the Rooted Collybia (*Collybia radicata* Relh.) and the Velvet-stemmed Collybia (*Collybia velutipes* Curt.), are classed as edible by Professor Peck, in the 51st report of the New York State Museum.

EXPLANATION TO PLATE.—1. Mature, expanded plant of collybia platyphylla Fr., showing radicating base of the stipe; 2. A smaller plant; 3. Vertical section through pileus and stipe; 4. An abortive plant, with the pileus almost entirely undeveloped and the stipe much swollen.

The Insect-Visitors of Iris Versicolor.

JOHN H. LOVELL.

Larger Blue Flag (*Iris versicolor* L.). There is no blue-colored flower so abundant or conspicuous in the marshy meadows of New England in June as Iris versicolor. The perianth consists of six violet-blue segments in two series, united below into a tube which is adnate with the three-celled ovary. The three inner segments, or petals, are erect, narrow and spatulate; the three outer are much larger, reflexed, dilated at the end and prolonged into a narrow claw. At the base of the outer segments, or sepals, are the nectar-tubes, containing an abundant store of nectar, which may be four to five millimeters in depth. The limb is violet-blue, the claw yellow above and greenish on the under side, and both limb and claw are marked with dark purple veins which serve as honey-guides.

The three arched petaloid styles stand opposite the sepals protecting the honey and anthers and determining the path of the insect visitor and the manner of fertilization. Teratological instances of petalody of the style are occasionally observed, but as a normal condition it occurs in comparatively few genera. Near the apex of the style is the white scale-like stigma. When the flower expands this is pressed upward against the style, but in the course of twenty-four hours it is reflexed, projecting outward like a shelf, and finally is recoiled. This was the case with flowers brought to my room for examination and with buds permitted to expand in water. The anthers dehisce as soon as the flower opens or shortly after. The length of the stamen varies in relation to the stigma. Ordinarily the anther is so far distant that self-fertilization is impossible, but occasionally it extends as far as the stigma and may even surpass it. Self-fertilization is then possible. In one specimen the stigmatic surface was coiled backward so far that it rested directly against the under side of the anther. The stigma was in a receptive condition, but the pollen had been entirely removed from the anther-cells.

The possibility of self-fertilization in the genus Iris does not seem to have been observed before, as, according to Muller, Iris pseudacorus L., is never self-fertilized. The modification described is interesting since it shows that in the absence of insects a race of self-fertilizing plants might arise. Such an instance of reversion is believed to have occurred in Ophrys apifera, the bee orchis. The pink color and adaptations of the lip and pollinia indicate that the flowers were formerly entomophilous, but though Darwin watched the plants long and often he never saw them visited by any insect. "Judging, therefore, from the structure of the flower of O. apifera it seems almost certain that at some former period they were adapted to cross-fertilization, but failing to produce sufficiency of seed they became slightly modified so as to fertilize themselves." We have thus, he adds, in the same flower elaborate contrivances for directly opposite objects. It is probable that variations occur in many flowers commonly regarded as dependent upon the agency of insects whereby they are occasionally rendered self-fertile. Henslow expresses the opinion that certain plants deprived of their particular visitors by transportation to foreign countries may regain, or at least acquire, the power of self-fertilization.

Of hymenoptera the honey bee is a very frequent visitor. After resting upon the broad landing-place afforded by the sepal it enters the narrow passage beneath the style and creeps downward to the nectar, rubbing its back first against the stigma, if reflexed, and then against the oblong anther which dehisces extrorsely. In many flowers the styles and sepals stand so firmly and closely together that it is impossible for the honey bee to obtain the honey except in the legitimate way. In other flowers they stand so far apart that this bee easily climbs in and out sideways, obtaining the nectar without rendering any service in return. I have often seen it vainly endeavoring to enter flowers of the first form in this manner, and only relinquishing the attempt after repeated trials. The blossoms of Iris appear well adapted to bumble bees, but I have taken only a single specimen, and my experience is similar to that of other observers. Halictus similis is a frequent visitor, and I have seen two at work on the same anther. When the anthers are immature the insects employ the mandibles to break them open.

In New Hampshire C. M. Weed states that this species of Iris is often sought by a syrphid fly, but in this locality diptera rarely enter the flowers and I have collected only the syrphid fly, Helophilus conostomus. In my room I have noticed the common house-fly probing between the style and perianth for honey.

Butterflys evidently, from their structure, can not visit the flowers legitimately, but they often steal the honey, thrusting the proboscis in sideways. A species of Pamphila sucks the honey standing on the ovary, while the larger banded red butterfly, Limenitis disippus, flits from flower to flower, but rests upon the upper side. I also observed an hymenopter, which escaped capture, examining the center of two flowers apparently searching for nectar.

While beetles are attracted to the flowers they do not act as agents for transporting the pollen. I have several times taken the rather peculiarly shaped black beetle, Mononychus vulpeculus, which I have never met with on any other flower. In one instance one of these beetles had been caught and killed by a brown spider. Donacia rufa was taken on the sepal. While hastening homeward to avoid a rapidly approaching thunder-shower I noticed that the handsome beetle, Leptura chrysocoma, had sought shelter in the center of the flower. At such times insects are unusually sluggish.

A white spider, a species of Misumena, sometimes takes its stand on one of the petaloid styles. When the seed-vessels of a buttercup were held before it, immediately it advanced to the tip of the style with the head and front pair of legs extended to grasp its supposed prey.

The insects found upon the flowers may be separated into four classes; those which prey upon the guests, insects attracted by the color, but finding neither pollen nor honey, butterflies sucking but not acting as fertilizers, and finally the true visitors effecting fetilization. With the close of the period of inflorescence the petals wilt and hang downward. The sepals, however, roll inward, wrapping themselves about the stigma and continuing to coil up, carrying the styles with them, until the ovary is reached. If by any chance the style is not caught by the sepal, which is rarely the case, it does not of itself coil inward.

Visitors—Hymenoptera—(a) Apidae: (1) Apis mellifica L., common, sucking; (2) Bombus consimilis Cr., rare; (b) Andrenidae: (3) Andrena claytoniae Rob., sucking and collecting pollen; (4) Halictus similis Sm., very common, c. p.; (5) H. palustris Rob., common, c. p.

Diptera—Syrphidae: (6) Helophilus conostomus Will., rare.

Lepidoptera—Rhopalocera: (7) Limenitis disippus Godt.; (8) Pamphila sp.; both sucking, but of no service in fertilization.

Coleoptera—(a) Lampyridae: (9) Lucidota atra Fab.; (b) Cerambycidae: (10) Leptura chrysocoma Kirby; (c) Chrysomelidae: (11) Donacia rufa Say; (d) Curculionidae: (12) Mononychus vulpeculus Fab, collected upon the flowers, but neither sucking nor feeding on pollen, and of no aid in pollination. June 24th, July 5th. Waldoboro, Maine.

Pontederia cordata L. In the August *Bulletin*, 1898, eleven visitors are enumerated. A clear-winged moth, Hemaris thysbe, has also been observed poising before the flowers and sucking the nectar. The blue spikes were examined July 20th, during the calm preceding a thunder-storm, and on nearly every one, two or three specimens of Halictus crassicornis were found resting transversely in the perianth. So inactive were these bees that no net was required and they were shaken off directly into the cyanide jar. Some fifty were taken, and an indefinite number might have been easily collected. They had evidently sought refuge here against the on coming storm.

Hints to Teachers.

DR. W. J. BEAL.

1. The chief object of the study of botany is to learn how to see quickly and accurately, and to acquire the habit of inquisitiveness. When acquired the training should be a never-ending source of pleasure and profit. This line of work naturally includes a knowledge of trees and shrubs because they are large and conspicuous; the most common weeds, grasses and plants in cultivation in field, garden, orchard, and for home decoration. It also includes something of plant morphology and the study of plants with relation to each other and their environment, their life history, known as *ecology*. This includes the study of seedlings, the changes taking place during a growing season, pollination by aid of insects and other means, seed dispersal, the struggle for room, plant defense, etc.

2. In these days most of the books are made with reference to beginning the study with the lower families by studying a number of what are selected as isolated types, and in this introducing the use of the compound microscope. After such a course, the pupil knows so little about the selection of materials that he is likely to abandon the work in after years unless he is under the guidance of a teacher. This work is attractive to many, and useful, but it involves considerable apparatus, small classes and long hours, which are seldom, if ever, secured in high schools.

3. A knowledge of plant physiology—how plants feed and grow—is very important, but it involves a considerable knowledge of chemistry and physics, as well as a great deal of apparatus; and the study of chemistry and physics, President Elliot and many other eminent educators say, should come after the study of botany and zoology.

4. As our schools now are and are likely to be for a long time, I think it best for high schools and those below to limit themselves mainly to what comes under my first heading, and rely on the future for the other two. In a thorough study of the first, more or less of the second and third will be introduced.

5. As to methods, teachers must be trained in the correct way, and then persistently struggle with boards of education for small classes and more time for each lesson. The number should be twenty or less in each class and the time for a lesson not less than 90 minutes; and then fully nine-tenths of the time should be devoted to laboratory work, with plenty of specimens and other material on hand for dissection and comparison. In this should come a correct use of a stage microscope, with needles, forceps and knife; always studying the plant carefully before using a book or text. In a former note in the *Bulletin* I told how to have an abundance of material at all times of the year.

After all, a first-class teacher will succeed in almost any way, provided he believes in it and gives the subject his best thought, and such a course can not help benefiting the pupils.

Half Hours with Lichens.--III.

THOS. A. WILLIAMS.

THE THALLUS.

The lichen is not a simple organism, but is a complex composed of a fungus in symbiotic relationship with one or more algae. The vegetative portion, or thallus of the lichen, varies from a delicate, scarcely perceptible film to a broad leaf-like body, and finally to a more or less upright, or pendant, much branched and often greatly elongated structure. The thallus, in its simplest form, consists of a mass of slender filaments (the fungal symbiont) interspersed with a greater or less number of green cells (gonidia) or algae. As the thallus becomes thicker and more complex, the filaments become more or less modified, and the gonidia occupy certain definite portions of it.

From their structure, appearance and position with reference to the substrate three types of thallus may be recognized, namely: crustaceous, foliaceous and fruticulose. The thallus of such lichens as grow beneath the surface of the substrate is generally quite simple in structure, and shows no protective or cortical tissue.

Examples of such thalli are found in *Pyrenula*, *Arthonia*, and a number of other genera. In the typically crustaceous thallus, however, evidences of differentiation occur, the filaments near the upper surface being arranged in such a manner as to form a protection to the gonidia which are placed in a more or less distinct layer, and are separated from the substrate by a second layer of hyphae. The higher crustaceous thallus becomes more complex in structure, and shows a fairly well defined upper cortical region, the cells of which are quite different in size and shape from those composing the hyphal filaments, and are usually closely agglutinated. This cortical region becomes well developed in the foliaceous thallus and usually occurs on both upper and lower surfaces. It is wanting on the under surface of some foliaceous lichens, such as the *Peltigeras* and some *Physcias*, but generally is readily noticeable on the upper surface; *Collema* being a notable exception, having no cortical tissue either above or below. As a rule, the foliaceous thallus shows well defined

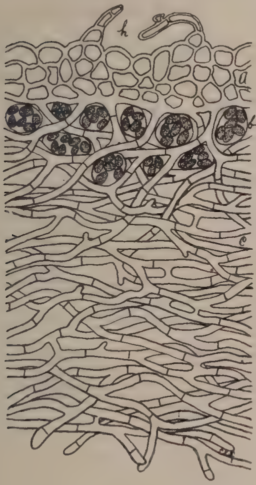

Figure 1.—Section of the Thallus of Peltigera rufescens; *a*. Cortical region of upper surface, composed of several rows of cells; *b*. Gonidial layer; *c*. Medullary layer, lower cortical layer wanting.

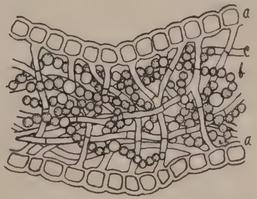

Figure 2.—Section of Thallus of Leptogium pulchellum; *a*. Upper and lower cortical layers respectively; *b*. Chain-like (nostoc) groups of gonidia scattered throughout the hyphae (*c*).

cortical, algal and medullary layers or regions (Fig. 1), but sometimes the last two are not distinguishable, the algae being distributed throughout the hyphal portion (Fig. 2). The cortical layer may consist of from one to several or many rows of cells, and is usually thickest on the upper surface. In the fruticulose thallus the structural elements are arranged concentrically, there being an external, cortical layer, followed by the algal layer, with a central medullary layer which sometimes forms a tough cord-like structure. In some instances the central portion may be hollow, as in the podetia of *Cladonia.*

In the higher foliaceous and fruticulose lichens the medullary and cortical tissues show adaptations for mechanical purposes, such as support and for aeration and conduction. Fine examples of supporting tissue may be observed in *Usnea, Umbilicaria, Cladonia,* etc. Adaptation for aerating purposes is seen in the cyphellae of *Sticta* and the ecorticate under surface of *Peltigera* and certain *Physcias.* Certain longitudinal bundles of filaments observable in many foliaceous and fruticulose thalli, probably function as conducting tissue as well as organs of support.

Frequently the cortical tissue of the lichen thallus becomes ruptured by the abundant growth of gonidia and hyphae from the gonidial layer. These ruptured spots (*soredia*) have a mealy or granular appearance, caused by minute, rounded masses of gonidia closely surrounded by hyphae, which are capable of developing into new thalli. The soredia are usually white or yellowish, and are sometimes so abundantly produced as to completely cover the thallus. They occur alike on crustaceous, foliaceous and fruticulose lichens.

The thallus is attached to the substrate by its entire under surface in the typical crustaceous species, becoming free at and near the margins in some of the higher forms, thus approaching the lower foliaceous type. Often, as in many *Buellias* and *Lecideas* the thin mass of filaments which serves to attach the thallus to the substrate is darker colored, and extends beyond the margin, forming a delicate fringe. This is known as the *Hypo-*

thallus. Sometimes it is white, as in some *Lecanoras.* It is usually wanting in foliaceous thalli, but is occasionally well developed, as in certain species of *Pannaria.*

In the great majority of foliaceous thalli the organs of attachment consist of hair-like outgrowths from the under suface, or *rhizoids.* These may be simple or branched and composed of one to many cells. They may be quite uniformly scattered over the under surface of the thallus or may be restricted to certain areas, usually at and near the center. They may be entirely absent from the marginal region, as in many species of *Parmelia,* or they occur in sufficient abundance to give the margin of the thallus a ciliate appearance, when they may be regarded as aerial rhizoids. The rhizoids are usually dark colored, most frequently black or dark brown, but they may be pale or even white. The thallus of *Umbilicarias* and some other foliaceous lichens is attached to the substrate at a single point by a short stem-like structure or "umbilicus" composed of cortical tissue.

The upper surface of the thallus may be smooth and even, or it may be powdery, granular or warty (verrucose); the warts sometimes become elongated, forming *isidia,* and the thallus is said to be isidioid. This frequently occurs among the species of *Parmelia, Collema,* and a number of other foliaceus genera, and may also occur on crustaceous and fruticulose thalli. Sometimes the surface of foliaceous and fruticulose lichens is provided with hairs (Fig. 1, b), as in species of *Peltigera, Theloschistes* and *Usnea.* The crustaceous thallus may be uniform, as in most of our species of *Graphis* and the earlier stages of many *Lecideae,* or it may become broken up into variously shaped areoles (areolate) as in *Buellia spuria* and many other *Lecideae.*

Shorter Articles.

Exceptions.

Some time since my attention was drawn to the exceptions to the general rules in certain plants. Lysimachia quadrifolia L., showed many variations. I presume most of us have found this species bearing throughout whorls of leaves in twos, threes, fours, fives, sixes, and even sevens. I found quite a curious one, having in the lowest whorl four leaflets, the next above five, the next five, the next four, the next four, then just one, then three, then one again, then two, and again at the top two.

The little partridge berry (*Mitchella repens* L.) often "breaks the rules," some of the blossoms having the corolla five-lobed, and some three-lobed, instead of four. I have often seen pairs of blossoms, one of which had four lobes, and the other three.

It is interesting to note the different forms of Rubus trivialis Michx. One may find flowers bearing six and seven petals very abundant, also a few with eight petals, some with nine, ten and even eleven. Occasionally the petals are rose-pink in color.—F. M. Graves, in Correspondence Bulletin, G. M. B. C. A. A.

The peculiarities of growth above mentioned are often seen in other plants. I lately found a five-leaved *Arisaema triphyllum* (Indian turnip), and *Hepatica triloba* very frequently occurs with five lobes. The Trilliums also sometimes present interesting exceptions. I have found them in fours, fives and sixes, the flower generally following the same rule with the leaves. But what is of most interest to know is, do these peculiarities repeat themselves in succeeding seasons? Probably not, as a rule. No new form remains permanent unless there is an advantage to the plant to be gained by it. Doubtless millions of these odd forms have appeared and soon vanished, because the plants can get along very well without them. And yet there are exceptions to this. Just as the sixth finger occasionally appears on the human hand, so by some peculiar condition of growth, not yet understood, do these marked exceptions continue to appear. If the cause is ever known, it will likely be found that the vigor of the plant has been interfered with in some manner—retarded or increased by the conditions of soil or climate.—J. A. Graves.

It seems that these "exceptions" are quite likely to be produced in abundance during seasons in which the conditions depart widely from the normal. Thus, the spring of 1896 was abnormally late and cold in the northwest. The early vegetation was frequently injured by the frosts, which were often quite severe and persisted well into the growing season. Many peculiar variations were noted among the plants growing about Brookings, South Dakota. In one instance a plant of *Populus tremuloides* bore catkins in which the flowers were all perfect.

A plant of the common garden Larkspur got its leaves and flowers all mixed up. The leaves, instead of having the normal green color, had stolen colors from the flowers. The flowers were wholly, or in part, green and the parts had reverted more or less to the ancestral leaf form. Even the stamens and pistils of a flower would be part or all green and leaf-like in structure.

A specimen of spiderwort (*Tradescantia virginica*) bore flowers in which the filaments of the stamens were more or less petaloid in shape and color. One of the stamens is shown in the accompanying cut (Fig. 1). In this case the stamen, through its expanded leaf-like filament was almost as large as a petal.

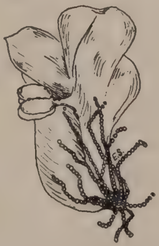

Figure 1.—Modified Stamen of Spiderwort showing bead-like hairs at base and expanded petaloid Filament with the Anther on one side.

The violets, too, came in for their share of exceptions, such as a flower with three spurs, eight petals and six stamens, and another with six sepals, eight petals, and six stamens, but with spur undeveloped.

Heliopsis scabra and *Helianthus maximiliani* gave numerous instances of "doubling" or the multiplication of the rays at the expense of the disk florets, while *Lilium philadelphicum* varied the program with a perianth composed of four parts and an androecium of four stamens.—Thomas A. Williams.

Woodwardia Augustifolia.

While out after evergreens for Christmas decorations I passed through a patch of low, damp woods, in which I noticed many fertile fronds of *Woodwardia augustifolia.* There were none of the sterile fronds visible, they having entirely withered away. Later I observed the same peculiarities in other plants in a similar locality, about two miles distant, and have noticed the same thing elsewhere. These discoveries led me to ask myself this question: "Are the fertile fronds of this fern persistent through the winter as are those of *Onoclea sensibilis?*" Neither Gray nor Britton throws any light on the subject. Can any member enlighten me?—Wm. H. McDonald, in Correspondence Bulletin, Div. A., G. M. B. C. A. A.

Among the Mycologists.

E. M. WILLIAMS.

The Chicago Mycological Society has, at its recent meetings, listened to lectures upon "The Identification of the Agaric," by Dr. Moffatt; "The Polyporaceae," by Dr. Pepoon, and "The Puff Balls," by Prof. E. T. Harper. The members of this society have an excursion each Saturday to some near point of mycological interest.

A Chicago collector reports that the Morels in the vicinity of that city are few in number, late in appearing, small in size and often distorted in shape. He asks if other collectors have noted whether a severe winter affects the size and form of these plants.

[Very fine specimens of both *Morchella esculenta* and *M. conica* have been found about Washington this season. They appeared rather later than usual, but occurred in considerable abundance and were often of very large size.—E. M. W.]

At a recent meeting of the Washington Mycological Club there was exhibited, through the kindness of Miss Mary L. Wilson and Mrs. Erismann, a series of about 80 colored photographs of fleshy fungi, mostly Agarics. The photographs were made by Mr. J. A. Anderson, of Lambertville, N. J., and colored in water colors from fresh specimens by his daughter, Miss H. C. Anderson. The photographs are natural size and the coloring exceedingly delicate and accurate. It is to be regretted that such illustrations can not be accurately reproduced at a reasonable enough price to make them obtainable by all students of these interesting plants.

A new mushroom enterprise has arisen in Washington, D. C. Mr. Fred J. Braendle, long known as an expert mycophagist, has undertaken to supply the market with native mushrooms. He gathers the species in season and puts them up daintily in wax paper in pasteboard boxes. Each box bears a label on which is stated in clear type that these mushrooms were carefully inspected on a certain date, and found to be all genuine and true to name, and in a perfectly healthy condition. The boxes are numbered and are accompanied by several recipes that may be followed in preparing the mushrooms for the table. Thus far *Coprinus comatus* and *Clytocybe multiceps* have been offered to the public.

The last meeting of the Washington Mycological Club, which was a field meeting, was held at Takoma Park. About 40 species of fungi were on exhibition, which, considering the early season (May 22), was a very good showing, since no member had more than an hour or two to spend searching for specimens.

One member of the Mycological Club reports having made a hearty meal of *Tricholoma rutilans*, and thinks it good. This fungus is classed among the suspects in popular European manuals. It is a beautiful fungus, but has rather too high a color to appeal strongly to the appetite. However, since eating is the proof of the pudding, this species may find itself among the elite of mushroom society yet. Has anyone else tried it? It is very abundant here both in spring and fall.

The genus Hygrophorus seems to have an unusual number of representatives this year. Already at Takoma Park, D. C., eight species have been found. It is one of the most interesting of all the Agaric genera, and one that can not help attracting attention, because its colors are so vivid and their combinations so striking. For instance, one species, which seems to be rare here, is almost a royal purple at first, changing to greenish, and finally, when dry, to shades of pink and yellow. Vivid crimson, clear yellow, and orange are common colors, while several pure white species are very beautiful. Anyone interested in this genus is invited to correspond or send specimens for comparison to Mrs. E. M. Williams, Takoma Park, D. C.

At the recent annual election of the New York Mycological Club the following officers were chosen for the ensuing year: President, C. W. Cushier; vice-presidents, Dr. W. B. Garside, Miss C. C. Bedford, and Mrs. G. W. Conklin; secretary, Mrs. A. R. White; treasurer, Thos. J. Keenan.

Mr. C. G. Lloyd has recently published another of his pamphlets on fungi. The last number contains descriptions of ten fungi, one of them (*Bolbitius sordidus*), a new species. To supplement this paper he has prepared photographs of all the species therein described, which he sells at the cost of printing. There is probably nothing obtainable in the way of illustrations that will be of greater assistance to the amateur mycologist than these photographs, together with the descriptions that accompany them.

In the May number of the *Bulletin of the Torrey Botanical Club*, Prof. L. M. Underwood describes a new Cantharellus (*C. multiplex*) from Maine.

Mr. Hollis Webster has a very interesting article on the fungi to be found in greenhouses, in the May number of *Rhodora.*

American Gardening for May 27, 1899, contains an article on the two poisonous amanitas, by Byron D. Halsted. The article is illustrated and the descriptions of the fungi are so complete that there is little excuse for one who reads the article to mistake these two amanitas for any edible species. It is very important that magazines and papers go on describing and figuring these species till they are as well known as poison ivy.

Among the Boleti collected at or near Takoma Park, D. C., last summer were the following species: *Boletus albellus* Pk., *B. alutarius* Fr., *B. alveolatus* B. & C., *B. americanus* Pk., *B. badius* Fr., *B. brevipes* Pk., *B. castaneus* Bull, *B. chrysenteron* Fr., *B. edulis* Bull., *B felleus* Bull., *B. fistulosus* Pk., *B. granulatus* L., *B. griseus* Pk., *B. hirtellus* Pk., *B. luteus* L, *B. miniato-olivaceus* Frost, *B. ornatipes* Pk., *B. pachypus* Fr., *B. pallidus* Frost, *B. piperatus* Bull, *B. parvus* Pk., *B. ravenelii* B. & C., *B. retipes* B. & C., *B. rimosellus* Pk., *B. roxanae* Frost, *B. rubens* Frost, *B. scaber* Fr., *B. speciosus* Frost, *B. subaureus* Pk., *B. subluteus* Pk., *B. variipes* Pk., also the nearly related *Strobilomyces strobilaceus* Berk, and *Boletinus decipiens* (B. & C.) Pk.

There were many others, but the "boletus season" lasted only about two weeks, and it was impossible to get all the species worked out from fresh material. We hope to add many more species to our list, and would be glad if those interested would help us complete it. This year, so far, only an insignificant *B. brevipes*, and *B. edulis* in considerable numbers, have appeared. The former is a late summer species, and the latter is due early in the summer, but is unusually early this year, besides being more than usually abundant. Its flavor is of the best quality, and although much troubled by insects, the plants are so large and fleshy that one or two make quite a good-sized stew. The species is easy to recognize because it is almost always in advance of the others, which enables the amateur to become familiar with it before the host of later species appear.

Recent Literature.

The report of the Boston meeting of the Linnaean Fern Chapter has just come to hand. It is a neat pamphlet of 31 pages and contains many interesting notes and observations on ferns and their peculiarities. A pleasant feature of most of the papers is the prominence given to ecological matters, showing that our "fern brethren" are alive to the importance of this line of investigation. Copies of the report may be obtained of the treasurer of the chapter, James A. Graves, Susquehanna, Pa., at twenty-five cents each. T. A. W.

Considerable of interest to mycologists has lately appeared in agricultural experiment station bulletins. The report of the New Jersey station for 1898 contains accounts by Dr. B. D. Halsted, of various fungi attacking cultivated plants, among which are the asparagus rust and two fungi which attack it, and the pear blight. There are also some interesting notes and statistics regarding the relation of the weather to the occurrence of injurious fungi. The paper is well illustrated.

Bulletins 163 and 164 of the Cornell experiment station treat of fungous diseases of plant. The first contains an account of three diseases of the sugar-beet, the second of the peach leaf-curl. Both contain illustrations of the species described. C. L. S.

The recently published work on "Living Plants and their Properties," by Drs. J. C. Arthur and D. T. MacDougal, is full of interest to teachers and students of plant physiology. The book consists of twelve individual essays or lectures, six by each author. Among the subjects discussed are the "Special Senses of Plants," "Development of Irritability," "How Cold Affects Plants," "Two Opposing Factors of Increase," "Significance of Color," "The Right to Live." The ideas advanced by Dr. Arthur in "Universality of Consciousness and Pain" and "Distinction Between Plants and Animals," are rather unique, and are discussed in an intensely interesting manner, affording food for thought and giving many suggestive hints to the student, although all may not be able to fully agree with the conclusions drawn. The book is a valuable one and is well adapted for the library of the general reader, as well as the teacher and student.

T. A. W.

A unique little volume has just appeared from the pen of Frederick LeRoy Sargent, entitled "Corn Plants, Their Uses and Ways of Life."* The book is designed especially for use in schools as a supplementary text and contains much valuable information, both historical and botanical, regarding the six important grain plants of the world—wheat, oats, rye, barley, rice, and maize, or Indian corn. The subject matter is presented in clear, non-technical language and is illustrated by 32 cuts, many of them original. A notable feature of the work is the attention given to the ways in which the various "corn plants" have adapted themselves to their surroundings. The discussions under "How they manage against wind, weight, and wet," and "Defenses against drought," are full of interest and are well calculated to set the student to thinking along lines too often given no place in popular botanical works, but which are all important in a proper understanding of plants and their "ways of living." Altogether the book should do much to increase the interest of old and young alike in these plants, so important to the human race, but so little known and understood by such a great part of it.

T. A. W.

News and Notes.

Dr. J. N. Rose, of the U. S. National Herbarium, will spend the summer in Mexico collecting and studying the rich flora of the country. Much of the time will be spent in company with Mr. C. G. Pringle, the veteran collector.

Through the generosity of Mr. Harriman, of New York, a party of scientists are to spend the summer in the study of the natural history of Alaska. Mr. Harriman bears the entire expense of the expedition, which will visit the more important localities chiefly along the coast. Among the botanists who accompany the party are Messrs. F. V. Coville and Thos. H. Kearney, Jr., of the Department of Agriculture; Dr. Wm. Trelease, director of the Missouri Botanic Garden, and D. A. Saunders, of the South Dakota Agricultural College.

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*Corn Plants—Their Uses and Ways of Life. By Frederick Le Roy Sargent. Houghton, Mifflin & Co., Boston and New York. 1899.

In the April number of the Botanical Gazette Dr. W. F. Ganong, of Smith College, gives an account of "Some appliances for the elementary study of plant physiology," which contains much of value to teachers, especially where funds for the purchase of apparatus for making experiments are limited, as is too frequently the case in the secondary schools and smaller colleges. Dr. Ganong has devised a number of pieces of apparatus, and, after having tested them thoroughly in his own laboratory and found them satisfactory, gives the results to the public through the medium of this paper, figuring most of the pieces and describing them in detail, so that anyone can have them made for his own use. The article discusses, "A Temperature Stage," "A Clinostat," "A Self-recording Auxanometer," "An Osmometer," "A Respiration Apparatus," "A Germination Box," "A Transpiration Device," "The Graduation of Roots, Tubes, etc.," and "A Root-pressure Gage."

There is abundant opportunity for teachers in the secondary schools to add to their botanical knowledge during the vacation season. Most of the universities and many other leading educational institutions are offering summer courses in botany, designed especially for teachers and others who are occupied with professional or other work during the greater part of the year. The University of Wisconsin, at Madison, offers five courses in botany under the direction of Professor Cheney. The session lasts from July 3 to August 11. At the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, Cold Spring Harbor, Long Island, the courses in botany will be given by Dr.

Johnson, of Johns Hopkins University. Two main courses are offered. Class work begins on July 5 and continues for six weeks, and the laboratory will be open until August 31st. The courses offered this season at the Marine Biological Laboratory at Woods Holl, Mass., are especially attractive. A notable feature will be the series of lectures on plant morphology and physiology, by Drs. Erwin F. Smith, D. H. Campbell, L. M. Underwood, Geo. F. Atkinson, H. J. Webber and other eminent specialists. Among other institutions offering summer courses in botany, whose notices have reached our table, are The Columbian University, Washington, D. C.; Cornell University, Ithaca, N. Y.

Columbus, Ohio, was the home for many years of William S. Sullivant and Leo Lesquereux, two names which will always awaken love and reverence from all students of North American mosses and hepatics. It is twenty-six years since Sullivant died, and this last quarter of the century has seen a marked extension of the limits of bryological study and a large increase in the number of students. It seems a fitting time and place to take a survey of the field, review the past and make plans for the future; hence it is proposed to make the coming meeting of the American Association for the advancement of Science, which is to be held at Columbus, the occasion for a Bryological Memorial Day in honor of the Nestors of American Bryology and to call on all botanists and botanical magazines to help make the occasion a memorable success. It is proposed to present a series of papers, illustrated by photographs, specimens and microscopical slides, as well as books and pamphlets, under the following topics:

Historical papers and collections showing the bryological work of Hedwig, Palisot de Beauvois, Michaux, Muhlenberg, Bridel, Torrey, Drummond, Hooker and Wilson, Greville, Sullivant and Lesquereux, James and Watson, Austin, Ravenel, Wolle, Eaton and Faxon, Muller and Gottsche.

Supplementing these there will be shown collections of specimens, macroscopic and microscopic, illustrating the monographic work of living American students.

If foreign students who have worked on North American Bryophytes can be persuaded to cooperate with us, the following will be asked to contribute: Bescherelle, Brotherus, Cardot, Dixon, Kindberg, Mitten, Pearson, Roll, Stephani and Warnstorf.

An effort will be made to secure the loan of type specimens and illustrations from the following sources: Academy of Natural Sciences of Philadelphia, Academy of Sciences of New York, Columbia University, Harvard University, the National Museum, Ohio State University, the University of Wisconsin and Yale University, as well as from private collections. It is also intended to exhibit any portraits, autograph letters and type specimens and drawings of special interest which may be loaned for the occasion, as well as presentation copies of books and pamphlets.

The following constitute the committee of organization: Prof. Chas. R. Barnes, University of Chicago; Mrs. N. L. Britton, N. Y. Botanical Gardens; Prof. W. A. Kellerman, Ohio State University; Dr. George G. Kennedy, Readville, Mass., and Prof. L. M. Underwood, Columbia University. They will answer any questions regarding the proposed memorial meeting, and give assistance to those wishing to contribute.

This enterprise should have the hearty cooperation of all American botanists, and we trust that readers of the *Bulletin* will do all they can to make the meeting a success. Between Sullivant and Dr. Gray there existed the closest friendship and intimacy. They worked together enthusiastically in the pursuit of their favorite lines of study, and American botany is much the richer for it. Sullivant's collection is now in the Gray Harbarium at Harvard.

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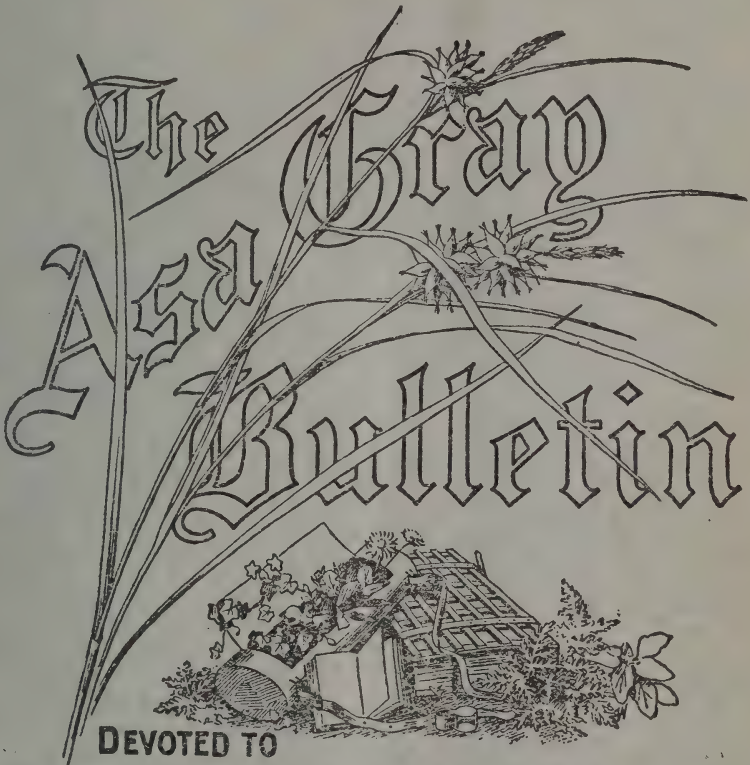

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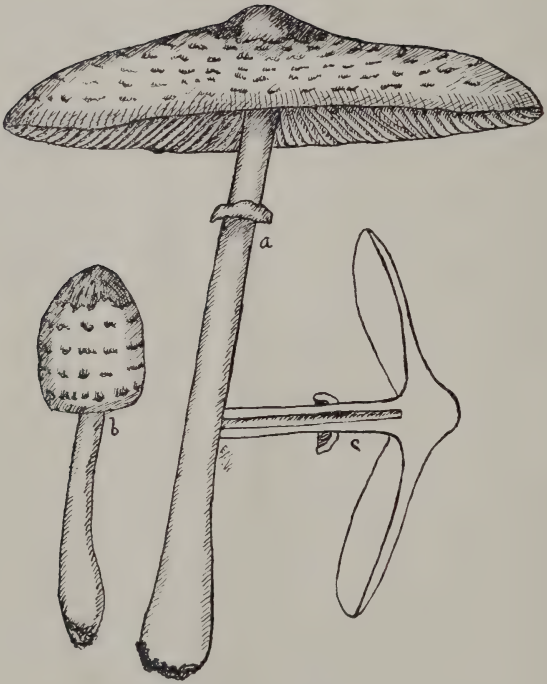

LEPIOTA AMERICANA.

a. Mature plant; *b*. Young plant; *c*. Section of pileus and a portion of the stem. All about two-thirds natural size.

Asa Gray Bulletin.

Vol. VII. No. 4. AUGUST, 1899. Whole No. 32.

The American Lepiota.—Plate V.

E. M. WILLIAMS.

The one really tractable genus among the fleshy fungi is Lepiota. Larvae bother the plants but little; they dry readily and when dry are flexible enough to go in folders without breaking or bulging unduly. Would that as much could be said of the other genera! The Lepiotas are so graceful and have such pretty colors and markings that is seems a pity that there are so few species in the genus. *Lepiota Americana* Peck, which we illustrate in this issue, is a very characteristic plant, and one easy to recognize from its congeners on account of the delicate red color which deepens perceptibly in drying or when handled. It was first described by Professor Peck in 1870, and later* he described the plant more fully and illustrated it in colors, giving it a place not far below the delicious parasol mushroom (*L. procera*) among the edible fungi; its only brawback being the red color it imparts to the stew. We who have learned to appreciate the delicate flavor of *Russula alutacea* will hardly find fault with it on that score. To Professor Peck's description he appends the remark: "The gills are sometimes connected with each other at or near their inner extremity by transverse branches; also the stem is often enlarged towards the base and then abruptly narrowed below the enlargement as in the Onion-stemmed Lepiota. In some instances the enlargement is not contracted below, and then the stem gradually tapers from the base upwards." The species is so rare here about Washington, D. C., that one can seldom find it in any quantity.

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*Pileus at first ovate, then convex or expanded, umbonate, squamose, white, the umbo and scales reddish or reddish-brown; lamellae close, free, white; stem somewhat thickened at or a little above the base, hollow, annulate, white; spores subelliptical; uninucleate, .0003 to .0004 inch long, .0002 to .0003 broad.

The caps vary in width from 1 to 4 inches, the stems are from 3 to 5 inches long, and 2 to 5 lines thick. Sometimes plants attain even larger dimensions than these. The plants grow singly or in tufts in grassy grounds or on old stumps. They may be found from July to October.—Peck, Rep. of the N. Y. State Museum, **49**: 56, *pl. 44, f. 6–10.*

Recently Mr. C. G. Lloyd, of Cincinnati, published a pamphlet containing a paper on Lepiotas and prepared, to illustrate it, a set of beautiful photographs. In his illustration of *Lepiota americana* the stem is almost even, quite thick and not much longer than the cap is broad, while in Professor Peck's illustrations the stem is relatively much longer. All the plants noted thus far from the vicinity of Washington, D. C., resemble Professor Peck's figures and description closely, and as yet we have only found the plant growing on and near stumps. Specimens collected not long since showed a distinct reddish tinge while fresh and growing.

Lloyd gives the range of this species as "from Louisiana North and East," and says it is a common late summer plant in the vicinity of Cincinnati. He finds the specimens growing in grass to be generally larger than those growing about the bases of old stumps and on decaying wood, and expresses the opinion that this species is the same as *Lepiota rachodes* of Europe, stating that while one European authority had pronounced specimens of the American plant to be unlike any European species, another had regarded them as " identical with *Lepiota Badhami*, Berk., and to *Lepiota rachodes* of most authors, but scarcely as described by Vittadini, which, according to his description, has not been rediscovered."

Botanical Work in the Grades and High Schools.

PROF. JOHN M. HOLZINGER.

During the past decade the methods of primary and secondary instruction in our country have undergone certain transformations with a rapidity so great that, in some quarters at least, the changes wrought amount almost to a revolution.

The pass-word along the whole line of operations has been nothing more or less than "nature study"; an effort at training the young mind in a way the most effective, because the most natural, beginning with that with which nature and necessity compels us to begin—things, objects, concrete, seeable, recognizable through the senses. Sense training. Yes; certainly, to begin with, and to end with, for the matter of that. Quick thought, energetic thought, goes hand in hand with, is stimulated by, quick and energetic sense perception. So, in the most healthful mind-growth our outer senses, "windows to the mind," must be widened, as it were, pari passu with the mind behind them. In our infancy this uniform advance is apparently the most natural. The child spontaneously observes and thinks himself into his surroundings, and that with a gleeful interest that can not but gratify the extremist in the doctrine of interest. So the outer world immediately surrounding the place of training of the young idea, whether the home or school, is doubtless the best arena for mental athletics, furnishes the most suitable material and problems for the growing mind. And, when "nature study" is stripped of all its irrelevant, incompetent conceptions, stripped of those features which endanger its claim to serious respect among reasonable, thoughtful teachers, the residue is an important step forward in our knowledge and theory of mind training; at least in the training of young minds. So much on the general trend of matters before taking up the question of botany in our public schools, including the high schools.

It is gratifying to see the increasing interest on the part of teachers of botany in our higher institutions manifested toward the elementary instruction by the publication of able and mostly very helpful books. I refer especially to the efforts of men like Professors Atkinson, Barnes, Bailey, and Beal. With such men to lead we may be sure that the product is certainly satisfactory botanical knowledge and training. I have observed with keen interest the points of divergence, of contact, and of agreement in the plans of these masters. Each doubtless is a lover of botany. And so far they are equally strong as teachers. But no less is this true of their numerous predecessors and contemporaries—all, in a spirit of love for the work, vie with each other to produce the best possible working plan, most serviceable for the present day and generation. And, in one way and another, each one doubtless hits the target somewhere, and hits it to his satisfaction. And why should this not be so, when in most every case the author, an enthusiastic and successful teacher, has simply put in book form the plan which for him was the most satisfactory, because most successful.

Now, without passing criticism or making imputation against or for any individual plan, let me briefly summarize the several lines of effort suggested by different teachers. One says, since botany is the science of plants, we must strive to give some knowledge of the great groups of plants; we must know, when we are through the "course," something about flowering plants, acrogens, mosses, lichens, fungi, algae. A synoptical view is the main aim. From another standpoint a knowledge of plants as things is inadequate, without a knowledge, both of physical and chemical forces that have conspired to make a plant what it is. Here the physiology of plants is deified. Still another standpoint, linking itself closely to and a part of the physiological view, insists that we must approach the life and being of plants by the plant cell; cell activity, and cell differentiation alone explain adequately the plant and its cycle of existence, whether flowering or flowerless. And, if we are to live up to Professor Goodale's definition that "Botany is the science which endeavors to answer every reasonable question about plants," our efforts at becoming comprehensive botanists need to include systematic, physiological and histological botany.

Now, I believe a brief aside into the society of those known as botanists will do a world of good to the hundreds and thousands of humbler teachers of botany, who are not comprehensive botanists, and who make no claim even to be called amateur botanists. First, it is an open secret that our foremost physiological botanists, with hardly an exception, do little, if anything, in systematic work. Secondly, few, if any, systematists have either time or inclination to arrange physiological experiments or solve physiological problems. And it is not too much to confess that such a being as a well-rounded botanist, in the sense indicated above, has not been known to exist in the flesh. From this standpoint at least, i. e., from the standpoint of aiming to fashion our common school and high school children into actually existing ideals, as botanists, even though they become only synoptically so—to be filled out later on—the efforts at attempting in and below our high schools all the essential lines of botanical work, microscopic and physiological as well as systematic, for completeness sake, are apparently not called for; we are fashioning toward on impossible ideal!

However, as a matter of fact, the amount of physiological and of systematic botany that may be inculcated into our young people in and below the high school is not likely to leave the recipient in the delusion that he is a full-fledged botanist. The question at that stage, moreover, is not so much, how much botanical knowledge has been imparted? It is rather, how much mental ability has been called out, how much stern but agreeable training has the study afforded, such training as will make for a better and abler citizenship? Of course, if any really valuable mental discipline is to result, the technical knowledge, so far as it enters into the educational process, must be exact, correct, and satisfactory to the specialist. We have scarcely one special botanist in a thousand citizens. It is not our purpose to discuss how or where that one gets his training. The other thousand or more are the ones with whose education our common and high schools are concerned. It is their privilege to use their eyes and minds on all the objects in the realm of nature, in the midst of which they are placed, and to learn to appreciate, enjoy and think reasonably about the things they encounter in the process of their training. That plan of instruction which is most readily adaptable to the training of the masses of our young people, whose schooling ends with, or even before, the high school, will be the one most generally adopted. And this is the question which hundreds of teachers have attempted to answer in the past ten years. Many doubtless have answered it satisfactorily to themselves. But when tried by others, their plan has been a veritable armor of Goliath, unwieldy and useless. And so, when the unfortunate little David happened not to possess a sling of his own, the result was too often of necessity no fight at all, in the line of this work. And yet it seems to me that this subject of botany deserves to attain to a more universal and uniform success as a permanent subject in our common and high schools than it has yet reached. I can indicate only briefly the line of effort along which these much-desired results seem to me attainable.

First, the teacher must know enough of the workable part of the subject to be in love with it; he must be an out-door, close student of plants. When a teacher in botany does not know the larger plants in the vicinity of the school as fast as he meets them, both the students and patrons of the school view him with suspicion and distrust. His knowledge of bacteria, algae, fungi, root tips, etc., does not avail him in the present crisis if he fails to "distinguish a cabbage head from a watermelon." Without doubt the children have the right to expect intelligent, effective instruction on the larger plants occurring in their surroundings. And without doubt it is the teacher's duty to so instruct them. This is only straightforward business.

Secondly, the equipment of the pupils must exclude any expensive appliances. A sharp penknife, tweezers, mounted needles, soft and hard pencils, well sharpened, and neatly kept writing and drawing book, are all that I would require in a three-months' high school course. A hand magnifier or dissecting microscope is all the students ought to be taught to use in their work in the high school. A compound microscope, or several if the school can afford it, are not an objectionable feature of the equipment, affording to the skilled teacher opportunity to show, occasionally, the wonders of nature that lie beyond the naked eye. But I believe sincerely that the sooner we learn to consider compound microscopes as an unnecessary, though it may be a very interesting feature of our high school equipment for botany, the sooner we shall learn to appreciate the many excellent opportunities all about us for observing the phenomena of plant growth with the unaided eye. Let us be reasonable, and exhaust first our natural resources of observing with the naked eyes the gross objects and organs of nature. That was a most remarkable demand made by a school superintendent in one of our prairie States recently, that it was time that the plain truth be told; that our grade teachers ought not to be so ignorant as not to teach the children the wonders of the microscope! That superintendent ought to have known that there are sound physiological and pedagogical reasons why grade children certainly, and younger high school children probably, should not use microscopes in their nature study work. And it may be considered a matter of providential good fortune that in the great majority of schools the financial condition safely settles this much misunderstood problem.

Thirdly, the material to be studied must in most cases be the plants that may be found within reach of the student. The most interesting, and the most satisfactory to study, certainly for the beginner, have always been the flowering plants. It is not too much to say that, under a natural plan of teaching, these same flowering plants will ever be the part of the plant kingdom that will receive the most generous share of attention. It is not intended to give the impression that flowering plants are the "whole of botany;" it is, however, desired to allow the royal group among plants to assume its well-deserved place in the minds and hearts of the masses of the young. I say "royal group," because it includes all the giants among plants, as well as that which most attracts and interests the eye, whether it be tree, shrub or herb. Circumstances may necessitate the study of lower plant forms as part of the work. And, indeed, a well-informed and interested teacher may arouse in his class as much enthusiasm over the fungi or lichens of the neighborhood as over the flowering plants; if he has the latter he will certainly not neglect them.

There is one phase of this question of the teaching of elementary botany to which I am not aware that attention has been called in the discussions of recent years, at least not in a pronounced and forcible manner. I refer to the problem of whether the young minds which are the recipients of our botanical experiments and "dopings" are better able to cope with the simple mechanical relations of organs, which occupy their attention in the elements of systematic botany, or whether they receive more profit and pleasure by attempting to probe into the more abstract principles which control and determine the development of plant life; whether it is better for the children to do more systematic or more physiological work in botany. I am now thinking only of the younger children, and for the sake of argument will assume what is true in scarcely one case out of twenty, that the average common-school teacher is competent and interested enough to do both lines of work well. That a specially interested teacher should arouse enthusiasm in physiological botany is not to be wondered at. That many classes, under such inspiration, have received good training and derived much pleasure is not to be denied. But this does not answer the query whether they would not have received as much or more profit and pleasure by following the other line of work. The fact is that children follow out more readily concrete relations than abstract principles. This is doubtless the point that Dr. Gray had in mind when he prepared for the schools of this country his Lessons and Field Botany. And it is capable of exact proof that whatever of really helpful suggestions are offered to our teachers of elementary work in the numerous "Texts" and "Lessons" on "Plants," are adaptions and enlargements, if not simple copies, of the strokes of the master. Dr. Gray and Dr. Goodale had equal opportunity to give to the schools of our land that from the storehouse of their experience, equally rich in each and for each, which would elevate, ennoble and cultivate the minds of our younger children. And it is a lasting monument to Dr. Gray's ability as a teacher of children that he chose to lay out a line of work that struck a responsive chord in the hearts of thousands of teachers and their pupils. Dr. Goodale was too prudent to attempt to bring his line of work to the level of children, requiring as it does broader training to begin with. And the teachers of our present generation will do well to take a lesson from these masters. The recent tinkering in botanical teaching, and the efforts at crowding out Dr. Gray's method of studying plants, so persistently made for several years from high quarters, have hindered rather than aided the healthy development of botanical knowledge among our young people. And, I repeat, whatever of redeeming and uplifting efforts are being made are planned in the exact lines of Dr. Gray's Lessons.

To sum up this mater, following are the points I have attempted to indicate:

1. The effective teaching of children should begin with objects, not with principles and generalizations.

2. The phase of botany which lends itself best to this plan is found in the simpler facts of systematic botany, and that principally of flowering plants.

3. Only the larger objects and organs should engage the attention and thoughts of the learner in the first years. Microscopic objects and structures should be avoided, because the child's nerve matter and thinking ability are undeveloped, and because the facilities for microscopic work are too generally absent as a matter of necessity.

4. It goes without saying that every teacher who loves field work takes his students with him as often as circumstances permit, so that their attention may spontaneously turn to the so-called "ecological relations" of plants, answering the question, Where and in what company?

In closing, I desire to call attention of all interested, briefly to the fact that if this plan were uniformly followed in the primary and secondary schools of the country, the oft-repeated complaint by university teachers, that the observing powers of young men who come into their charge are frequently well-nigh atrophied, would be much less frequent if they did not cease altogether. And the work of the teachers of botany in all our higher institutions would be greatly furthered, would certainly be more effective. As matters go at present, our university-trained high-school teachers of science too often practice university instruction on their pupils, and succeed admirably in spending the time and dulling the relish for later work.

Carices in the Vicinity of Philadelphia.

C. F. SAUNDERS.

In the latter part of April in the neighborhood of Philadelphia *Carex stricta* and *C. Pennsylvanica* are found in flower, the former growing in great tussocks in low meadows and marshes; the latter most abundant in the leafless woodlands, a charming little plant well marked by its lance-shaped, reddish-brown, sterile spikes terminating the culm, and its pronounced habit of spreading by underground runners. Following hard upon these come the varieties of *C. laxiflora*, another woodland species. Especially noticeable in rich woods near Philadelphia, is the variety *latifolia*, whose broad green leaves persist throughout the winter. The triangular, blunt-edged perigynium of *C. laxiflora* and its varieties, thicker above than below, and provided with a short beak bent to one side, is a characteristic feature making the plant comparatively easy of recognition. In the woods of May the Carices come thick and fast; *C. rosea*, sending up from a tuft of grassy leaves slender culms on which the seed vessels are strung in star-shaped clusters; *C. pubescens*, with perigynium and leaves clothed with heavy hairs; *C. virescens*, its tall, graceful culms each topped with oblong, erect spikes of close-set, hairy seed-vessels; *C. triceps* closely resembling the last, but with shorter, stouter spikes usually clustered in threes. Occasionally in rocky woods, *C. platyphylla* greets us with its broad glaucous leaves, cradled in the brown dry ones of the old year. In the grassy margins of the woods *C. cephalophora* loves to grow, a dignified plant with spikes bunched in a compact head at the summit of its upright culm. In the wet woodlands one of the most delicate of Carices is *C. tenuis* (*debilis*); spikes of slender seed-vessels taper at each end, drooping gracefully on threadlike peduncles. In similar situations the equally graceful *C. gracillima* may be found.

Associated in the wet meadows and marshes are the variable *C. vulpinoidea*, its irregular sized, often compound spikes disposed in long clusters interspersed with bristles; *C. scoparia*, with nodding clusters of soft, brown, cone-shaped spikes; *C. stipata*, with weak, sharply triangular, succulent culms, tipped with bristly clusters of awl-shaped seed-vessels; *C. crinita*, its fringed spikes looking very picturesque as they hang by slender stalks from the long, drooping culms. Everywhere in meadows and ditches and by roadsides the stout, rotund spikes of *C. lurida* bristle and will be found all summer long, after most other Carices have sown their seed. Damp meadows also yield *C. granularis*; and *C. grisea* is to be found in moist spots in thickets and woodlands.

To the south of Philadelphia is the low island of Tinicum, formed by the delta of Darby Creek, a tributary of the Delaware River. The flora of this island is more like that of Southern New Jersey than of Pennsylvania, and includes several of the rarer Carices. Among them may be enumerated *C. littoralis*, a beautiful species with prominent, purple scales; *C. ptycocarpa*, a low sedge whose delicate spikes are almost hidden in the leaves; the stately *C. vestita* with *C. foenea* and *C. caroliniana*. Here, too, growing in tidal mud along the Delaware, *C. vulgaris* was found last spring; a northern species resembling *C. stricta*, but very rare as far south as Pennsylvania.

The above does not pretend to include all the Pennsylvania species of *Carex* to be found near Philadelphia, but will serve to give an idea of the variety which the collector may readily gather in a season without going farther from the town than an afternoon outing will permit.

Notes on Amanitas.

E. M. WILLIAMS.

July and August are the months when the Amanitas are most abundant. Many of them are so large and so perfect in form that they always attract students of fungi. Compared with other groups they are not difficult to work out, yet one who masters all the Amanitas of his section in one moist summer, such as we are having this year, will have little time for any other group. The principal difficulty in this section seems to be with a number of undescribed species or varieties that persist in showing themselves occasionally. The beginner usually is first attracted by the brightly colored species which are not difficult, but the white species are much harder to separate, and often prove to be riddles very difficult to solve. There are about half a dozen white species that are distinct enough when once known, but the descriptions fail to emphasize the distinguishing characteristics, and the confusion that results is disheartening. It is one of the up-hill places in mushroom study, and the only thing to do is to begin afresh every time the unknown makes its appearance, and at last the individual will become an acquaintance even though the name remains unknown.

As an instance of the wealth of material at hand, the writer of this article has had brought in mostly by amateurs, during the past week (July 20-28), twenty different species of *Amanitas* (including *Amanitopsis*).

The following species have been found in the vicinity of Washington, D. C., during the present season:

Amanita caesarea Scop. Quite common in edges of woods.

A. spreta Pk. Not common.

A. phalloides Fr. Scarce as yet; very abundant later.

A. phalloides Var. *verna* Bull. Found occasionally.

A. virosa Fr. Quite common; not always pure white; stem often with reddish stains, fainter, but not unlike those seen in *rubescens*.

A. pantherina D C. Not at all common this year.

A. muscaria Linn. Only an occasional specimen found as yet; is abundant later; varying in color from pure white to an orange that is almost red.

A. frostiana Pk. This agaric is so variable, or there are a number of closely related forms resembling it, that it is difficult to determine. Professor Peck pronounced specimens of the small form sent him early in the spring true *frostiana*, but the later, larger and more abundant specimens differ in many respects from the description of the species, and may prove entirely distinct. As the species commonly appears here it is as different from *muscaria* as two amanitas could well be.

A. russuloides Pk. This Amanita was discovered and described by Professor Peck in 1871, and has not been recorded since. This year specimens were sent him early in the spring, which he said agreed well with the description, except that the plants were smaller than the type. Later the plant has been quite abundant and of much larger size.

A. candida Pk. There is some doubt as to this species, as it was determined from poor and insufficient material.

A. solitaria Bull. Not uncommon. One of the most striking of the white Amanitas.

A. strobiliformis Viet. Not very common, but of large size and beautiful appearance.

A. daucipes Mont. Large and very beautiful specimens were found early in the season, which were referred to this species.

A. abrupta Peck. Only a few specimens found.

A. chlorinosmia Pk. Quite common. Has no large warts, and is mealy all over, with the mealiness more dense in the center of the cap.

A. rubescens Pers. One of the commonest species and very variable; a well-marked variety occurs that has the warts and veil bright yellow.

A. vaginata Bull. Common from early spring. A yellow form is also sparingly found.

A. volvata Pk. Rather rare.

A. strangulata Fr. Not common.

A. farinosa Schw. Only a single specimen found.

Besides these there have been fully half a dozen that have gone unnamed, either from lack of knowledge, material or time for careful study and comparison of specimens.

Shorter Articles.

Some Notes from My Flower Garden.

For some time during the month of July, just past, I have had under observation the time of blooming of two plants, principally because they are never found in bloom at the same time of day. The one is *Hibiscus trionum* L., Bladder Ketmia; the other what I had always taken to be *Talinum teretifolium* L. The Ketmia opens its flowers at 7 A. M., and closes them at 1 P. M., while the Talinum blooms from 3 to 6 P. M., closing its flowers within a half hour after six. The latter species has received considerable attention from me. It is represented by some twenty plants of different sizes scattered over a square yard of sandy soil, exposed to the sun. The patch is kept clear of all other plants. A little less than a year ago I collected a number of specimens of this plant on the sand dunes near Trempealeau Mountain, where it is associated with *Hudsonia*, *Tephrosia*, and *Petalostemon villosus* Nutt. Some of these I had planted in my garden, in the expectation that, since the plant is recorded as a perennial, it would live over winter and come up from perennating portions under ground. On examination this spring not a trace of the plants was found to remain. I did not expect to see anything more of my *Talinum*. A little later, when the numerous species of weed seeds, which I kept under observation with my botany classes, began to raise aloft their cotyledons, to my surprise and joy I saw quite a number of minute seedlings with *terete* leaves. Many of these have since developed into sturdy plants, bearing from one to twelve slender, several flowered scapes. And for the last three weeks of July these plants have bloomed profusely; from thirty to forty flowers usually are found open together, presenting a pretty sight, provided you "happen in" at the right time, which, as I said, must not be before 3 nor after 6 P. M.

I had already noted the discrepancy in the duration of this plant from *T. teretifolium*, when, on turning to Professor Harshberger's paper (Bull. Torr. Bot. Club, Vol. 24, April, 1897), I find that he assigns the hours from 1 to 4 P. M., approximately, as the hours of bloom for the true *Talinum teretifolium*, remarking (p. 187, l. c.), "The other species of *Talinum* differ from *T. teretifolium* as to the time of opening of the flowers, so that *this peculiarity is specific.*" (The italics are mine.) Now, I have observed a dozen times that my sand dune *Talinum* never blooms except at the time stated. Yet, in all details, except the duration, and the time of bloom, the plant agrees exactly with the descriptions of *Talinum teretifolium* L. I would like to see seeds of a plant of *Talinum teretifolium* which is *known* to be perennial, and the flowers of which can be vouched for as opening from about 1 to 4 P. M. If any of the readers of the *Asa Gray Bulletin* can send me some ripe seeds of that *Talinum*, I shall be glad to send them in return seeds of my plant.

JOHN M. HOLZINGER.

Among the Mycologists.

Dr. H. S. Pepoon, president, and Prof. L. M. Umbach, vice-president of the Chicago Mycological Society, are making general scientific collections in Northern Ontario. Dr. W. S. Moffatt and Mr. Grant Wyrick will collect in Northern Michigan; Messrs. W. S. Bates and A. S. Bertolet in Southern Michigan; Dr. L. H. Watson in Connecticut, and Prof. J. B. Russell in Western Illinois. W. S. M.

The Chicago Mycological Society will use the card-index sytem for keeping a record of its work. Cards printed with suitable data are distributed to the members to be filled out, giving names of species, habitat, date, etc.; also in what form species are preserved in the herbaria of the collectors, with brief reference to any special studies made. These cards when filled out are returned to the secretary, who arranges them and keeps them on file for the use of the society and other botanists who may wish to consult them. W. S. M.

Apropos of the query in the June number of the *Bulletin* Mrs. G. W. Conklin, of the Brooklyn Mycological Club, reports plenty of Morels (*Morchella esculenta*), which were "of good flavor and fair size, although not as large as usual."

The members of the Pennsylvania Mycological Society have recently prepared a list of the fungi that have been reported from time to time. The number of species amounts to over two hundred and fifty. H. S. B.

The following additions have been made to the list of Boleti, from the vicinity of Washington, since the last issue of the *Bulletin*: *Boletus decorus* Frost; *B. flexuosipes* Pk.; *B. indecisus* Pk.; *B. miniato-olivaceus sensibilis* Pk.; *B. modestus* Pk., and *Boletinus pictus* Pk. The season for Boleti is just beginning, and we would be glad to receive reports of additional species from this region. E. M. W.

A member of the Washington Mycological Club reports the eating of *Cantharellus cinnabarinus* Schw., which, in spite of its peppery taste when fresh, proved delicious when properly cooked.

In the June number of *Rhodora*, Mr. Hollis Webster gives an interesting discussion of *Hydnum caput-medusae* and other species that are likely to be mistaken for it. He suggests that it is often confused with *H. caput-ursi*, *H. coralloides*, or *H. erinaceus*, and urges careful observations and comparison in order to determine the limits of the species.

Henry Holt & Co. promise, at an early date, "A Guide to the Systematic Study of the Fungi and Mycetozoa," by Dr. L. M. Underwood, of Columbia University. Few American botanists are as well prepared for the writing of such a work as Dr. Underwood, and the success of his work on "Ferns and Fern-Allies" assures us that we can expect something of great usefulness in the promised work on the fungi.

News and Notes.

A considerable addition to the "Flora of Michigan" has recently been made by Dr. Beal and Professors Wheeler and Longyear. It is published as a part of the "Report of the Botanical Department of the State Agricultural College for 1898."

"The Gulf Fauna and Flora" is the title of a new serial publication which has recently made its appearance under the editorship of Dr. W. Edgar Taylor, of the Industrial Institute at Ruston, La. The new journal will be issued bi-monthly, and will be devoted to biological questions relating to the plant and animal life of the Gulf region. We wish it a successful career.

Dr. J. N. Rose, of the U. S. National Museum, has just returned from a three-months collecting trip in central Mexico, where he has obtained a large amount of material that will aid in clearing up many puzzling questions in regard to agaves, yuccas, and other important economic plants of that country.

C. R. Ball, of the Iowa State Agricultural College, E. D. Merrill, of the University of Maine, and P. B. Kennedy, of Cornell University, have recently been appointed to positions in the Division of Agrostology, U. S. Department of Agriculture. W. A. Orton, of the University of Vermont, has accepted an appointment as assistant in the Division of Vegetable Pathology and Physiology.

W. T. Swingle, of the Department of Agriculture, has just returned from an extended trip abroad. He spent much of his time in Southern Europe and Northern Africa studying the economic plants of the Mediterranean region. He selected many varieties with which to experiment in the warmer sections of the United States, paying special attention to the figs and the citrus fruits.

The numerous sphagnum bogs in the northern part of the United States that have hitherto been regarded as almost worthless may yet yield a handsome revenue to their owners. Sphagnum has been used for packing plants, and recently for packing fish eggs, but investigations in Austria and Germany have demonstrated that owing to its absorbent, balsamic, non-conductive and elastic properties it is especially well adapted for use in stables, breweries and about drains and other places where non-odorous absorbents and disinfectants are required; for packing fancy fruits and other perishable or breakable goods, and for use in upholstering. Mixed with molasses it is used as a cattle food. In 1898 more than 6,000 tons of "peat moss," valued at more than $40,000, were imported into this country.

L. H. D.

Open Letter.

Editors Asa Gray Bulletin:

When it became known that at the Columbus meeting of the A. A. A. this year a Bryological Memorial Meeting was being arranged, it occurred to the writer that a brief compilation of the work of moss students now living, both here and abroad, including a statement of the vocation and opportunities of each, would add to the pleasure, both social and scientific, of those in attendance, if presented informally at the meeting. Accordingly, I prepared a circular suggesting an exchange with me of photographs by all interested in the study of mosses, bearing address and year of birth, and also asking from each information on the following points:

1. Your vocation. 2. The time you are able to give annually to the study of mosses. 3. A list of your bryological papers or larger works; also a list of exsiccati you have distributed. 4. Which genera or larger groups of mosses interest you especially? 5. Are you willing to have referred to you, for critical examination, species that fall in the line of your special interest? 6. Do you exchange mosses? If so, what material do you offer? 7. If you can do so at this writing, please state whether you expect to attend the Columbus meeting next August 21-26?

These questions have been so approvingly and enthusiastically answered by almost all active moss students that I am inclined to put the results of my present inquiry into more permanent form, such as may be put into the hands of each one interested. And in order to make my list of moss students as complete as possible, may I ask for the cooperation of our botanical journals by printing this notice, to give this plan the widest possible publication, even after the meeting. If for any reason a photograph can not be sent, I shall be very glad to get at least a brief statement to each of the above seven questions from anyone from whom I have so far not heard. The presentation of this plan at the Columbus meeting, from present indications, can be only preliminary and incomplete.

Hoping for a cordial and friendly cooperation of all interested, I am, fraternally,

John M. Holzinger.

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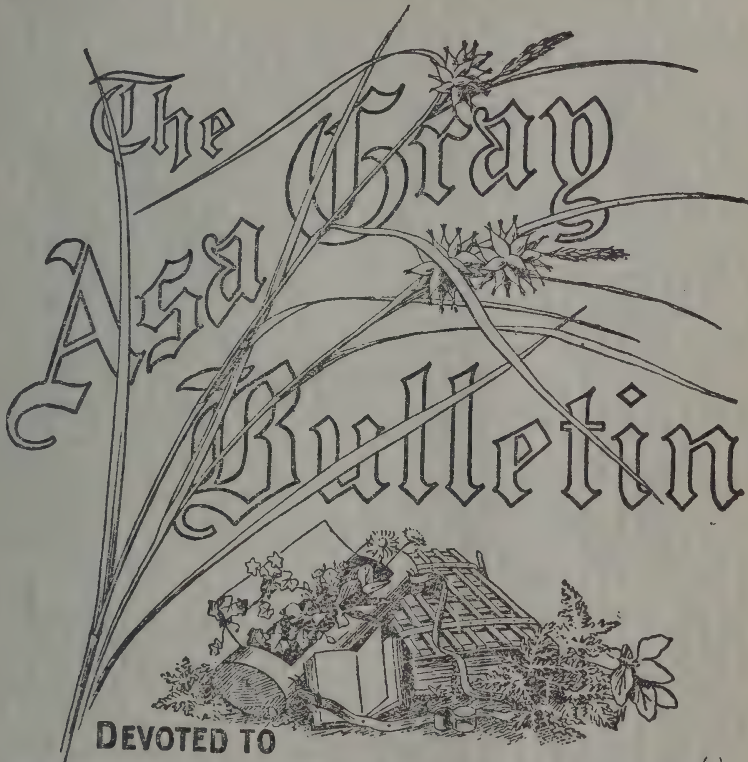

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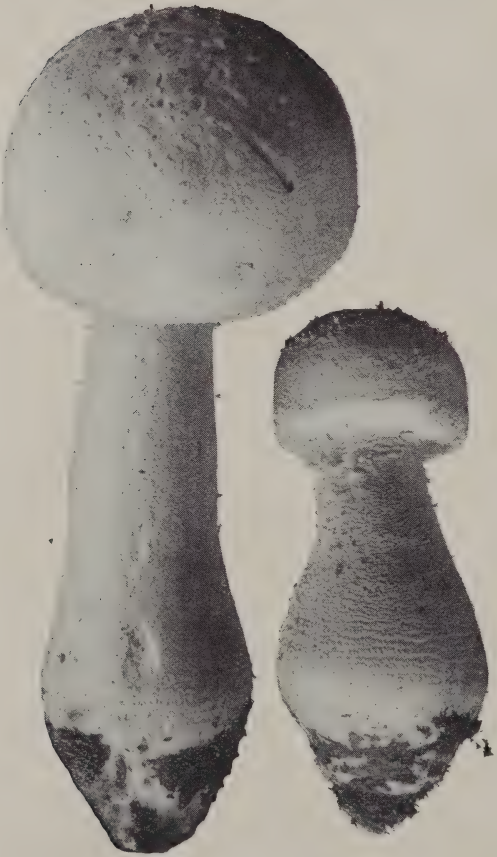

AMANITA STROBILIFORMIS.

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Amanita Strobiliformis Vitt. Pl. VI*

There is some doubt as to whether the American plant known under this name is specifically identical with that described and figured by Vittadini. The European plant is described as having the bulbous base subterranean, while in the American plant as illustrated by our plate, the bulb is usually entirely above ground. According to Mr. C. G. Lloyd, the European and American plants differ also in the shape of the bulb, the shape of the warts, and the manner in which the volva separates from the stem.

Our plant is certainly one of the most beautiful of the genus. In the stages represented by our plate it is pure white, with the abundant floccose scales of the stem and marginal portion of the pileus easily brushing off, but the warty scales of the central portion of the pileus quite persistent. The base of the stem is conspicuously rooting, and the mature plant often attains a large size, six to nine inches in height, with the pileus nearly or quite as wide when fully expanded.

Although of wide distribution, having been reported from North Carolina, Alabama, Maryland, District of Columbia, New York, Massachusetts, Pennsylvania and California, it is of rather rare occurrence and is seldom found in any great abundance. The European plant is said to occur in "grassy borders of woods," but our American form seems to prefer rather open woods or thickets, sometimes (as in the case of the specimens photographed) occurring in deep moist woods on rich leaf-mold. The plants are usually solitary, or but two or three in a cluster. European authors place the species among the edible fungi, some speaking very highly of its esculent qualities. The American plant has also been declared edible by a number of mycophagists. Two members of the Washington Mycological Club claim to have eaten it often, and pronounce it excellent. It should be approached with great caution, however, for there is danger of confusing it with the white form of *Amanita muscaria*. As in that species the cup-like base so characteristic of the "Death cup" (*A. phalloides*) is represented only by a series of scales on the bulb, and the plants are similar in other respects, especially in the younger stages. We would be glad to receive notes from any of our correspondents who are familiar with this species relative to its edible qualities, and also as to the relationship between the European and American plants.

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* AMANITA STROBILIFORMIS Vitt. Pileus white, becoming cinereous, convex, then expanded, pelliculose, the margin, which extends beyond the gills, even, warts hard, angular, and closely adnate; flesh compact and white. Stem solid, floccose-scaly, thickening downwards into an underground bulb, which is acutely marginate with (1, 2) concentric furrows. Ring torn. Gills rounded free. Spores, 8x10 mic.—Stevenson British Fungi, Vol. I, p. 7.

Botany in Secondary Schools.

DR. JOHN M. COULTER.

Formerly there was but one way to teach botany, for a single phase of it only was available. The gross structures of flowering plants were examined, and their names memorized, and the study culminated in "analysis," which by a strange misapplication had come to mean the discovery of the names of plants. With increasing knowledge this method of teaching came to seem very partial and superficial. It must be confessed, however, that many schools have not outgrown this primitive stage.

A second period of botanical instruction was ushered in by the equipment of laboratories with compound microscopes. Plants of the lower groups now came into notice, and some knowledge of the general "make-up" of the plant kingdom was developed. At first the pendulum swung to the opposite extreme, and the contact was chiefly with the lower plants, and through the microscope. The student familiarized with flowering plants out of doors became the student familiarized with structures under the microscope. Probably this is the favorite method of instruction in the better equipped schools to-day.

This method has been criticized as leading to no knowledge of plants as they exist in nature. The laboratory student, transferred to the forests and fields, seemed to have no more knowledge of his surroundings than he had before studying botany. It was questionable whether he could recognize in place the material he had seen only in the laboratory. Another important criticism was that students whose formal training ends with the secondary school, can not carry such a contact with plants into their subsequent experience and botany becomes a closed subject rather than one full of perennial interest.

A third method is coming into recognition, which seeks to combine the advantages of the other two, and also introduces an entirely new standpoint. The most conspicuous fact in reference to a plant is that it is alive and at work. In order to do this work, the organs must be related properly to their surroundings, and the study of these life-relations seems to be the natural approach to plant structures. For example, the life-relation of a foliage leaf is its relation to light, and this explains its position, its form, its relation to other leaves, and also its structure. In the presence of this great fact the names of forms and positions of leaves become matters of very small importance, and there is no danger of mistaking definitions of words for knowledge of things. Again, the life-relations of roots are various, as relations to soil, to water, to air, to mechanical support, etc. Perhaps flowers and their clustering have been more deeply buried beneath terminology than any other plant structures, but all of this is brushed aside when the life-relations are found to be pollination and seed-distribution.

This new standpoint does not abandon the microscope and the structures which it reveals, but it approaches them with a new purpose. Nothing can replace a general acquaintance with plant forms, for they must be known in order to illustrate the various methods of work. Nothing is simpler than to devise experiments in the laboratory to illustrate the common life-relations, and to supplement the experiments with observations in the field.

It is found further that plants are not scattered in haphazard fashion over the surface of the earth, but are organized into definite associations or societies. A certain combination of water, soil, heat, etc., determines a plant society, and in it certain plants are permitted and others forbidden. The study of these plant associations, the conditions which determine them, and the adaptations of the plants, is most interesting and important. School plantations can reproduce many conditions and plant associations, so that much of such study may be carried on in the laboratory.

For example, aquaria or glass jars can be used to contain representative forms of the common societies of water plants, as floating forms, swamp forms, etc., and their characteristic adaptations in position and structure studied. In boxes may be grown representatives of dry sandy ground societies, also societies of the more fertile soils, etc. To contrast these societies and their adaptations is full of profitable work.

Such a view of plants is a permanent possession, for every landscape becomes significant, and in the student's subsequent experience such material is constantly presenting itself. It is such a background that the universities desire for their botanical work, for the forms studied in their laboratories are thus put into their proper places in nature through previous experience.

The secondary schools can not introduce such work in revolutionary fashion, but must gradually intersperse it among the old work as training and familiarity with the material may permit. Those accustomed to an older method, and adjusted to its demands, in the presence of the new may feel the shrinking which comes from inertia, but this paper has in mind not the feeling of the teacher, but the good of the pupil.—Journal of Applied Microscopy.

Botanizing in Oklahoma.

PROF. E. E. BOGUE.

There are perhaps few regions in the United States that have received as little attention from botanists as has Oklahoma. It lies between Kansas on the north and Texas on the south, and hence includes more or less of the flora of both these States. One or two imperfect lists have been made and others are in preparation, but it will be several years before anything like a complete list of the plants of Oklahoma can be published.

The flora is interesting and at the same time perplexing on account of the varying climatic and soil conditions met with in the different parts of the territory. A species in the western counties, where the climate is very dry and the soil poor, will be much dwarfed, while the same species in the eastern counties, where the climate is moderately moist and the soil rich, will attain usual size or even abnormal growth.

No manual yet published contains all the species found here, so that one must have at hand at least three synopses and as many more as can be obtained, and often with all these, beside monographs of certain groups and a moderate sized collection, he is often in doubt as to whether he has a description of the plant in hand. There is here, as everywhere else, the possibility of new species.

The land is prairie, broken in many places by small streams, which usually make deep, narrow cuts through clay or sandy soil in a southeasterly direction. These are frequently streams in name only, for most of them are dry, except immediately after rain-storms. A strip of land a few rods in width along these channels supports a limited variety of shrubs and trees, among which are *Quercus macrocarpa*, *Hicoria pecan*, *Populus monilifera*, *Juglans nigra*, *Acer negundo*, *Cercis canadensis*, *Vitis rupestris*, *Vitis cordifolia*, *Prunus americana*, *Prunus gracilis*, *Gleditschia triacanthos*, *Celtis mississippiensis* and *Symphoricarpos vulgaris*. Sometimes these streams run among hills which support a more or less scattering growth of *Quercus nigra*—the most common tree in the territory.

The larger streams are the Salt Fork of the Arkansas, running through the northern part of the territory; the Red Fork of the Arkansas, or the Cimarron, running through the central part, and the Canadian River, forming the southern boundary of the territory. These are broad and comparatively shallow streams. The approaches are usually very wide, and here the soil is mostly sand, which supports *Helianthus annuus*, several species of tall grasses and *Populus monilifera*.

When one enters the territory from the north on any one of the three railroads he sees a broad expanse of prairie almost destitute of trees, shrubs and habitations. One may see at a distance what appears to be a stretch of thickly wooded country, but when such is reached it proves to be only scattering specimens of *Quercus nigra* growing in sand, and almost destitute of lichens, hepatics, and mosses. This is the kind of forest (?) that Washington Irving chased buffalo into in his "Tour of the Prairies."

The western part of the country is more level, but in the eastern part the prairie is broken in places by deep cuts with rocky sides. In these may be found a limited number of Filices.

Red sandstone crops out in many places. On surfaces that have been long exposed are to be seen a few species of crustaceous lichens and one species of *Parmelia*.

Another form of relief is the "draws." They occur in clay soil, have vertical sides and are caused by the settling down or washing out of U or V shaped portions in the side of a gently sloping hill. They usually have a broad mouth, and are more or less regular in outline. Along these "draws" are often found *Dalea laxiflora* and *Houstonia angustifolia*.

The natural bodies of water are few, but where present support a variety of aquatic plants, among which are *Nelumbo lutea*, *Marsilia vestita*, several species of *Sagittaria* and others.

As might be expected in such a dry region, the algae are not found in much quantity. The open prairie is clothed with rather a limited variety of grasses. Intermixed with them are many species of leguminous plants. In the more moist situations *Amorpha fruticosa* grows in abundance. *Amorpha canescens* is very common on the higher ground. *Baptisia australis* and *Baptisia leucophaea* are scattering, but frequent on the higher prairies; here are also found *Lespedeza capitata* and *Lespedeza sturei.* *Silphium laciniatum* occurs in exposed situations about draws. *Stillingia sylvatica* is frequent near creeks and rivers in sandy or clay soil. *Jatropha stimulosa* occurs in sandy regions in shade or exposed. The sting is much more severe than that of *Urticastrum divaricatum.* *Euphorbia corollata* and *Euphorbia marginata* occur in permanent or washed soil. *Euphorbia maculata* is a common weed here. *Cephalanthus occidentalis* is common in moist rich soil. *Juniperus virginiana* occurs along the Cimarron and in the eastern part of the territory. In the regions where this tree grows in this territory we do not find the usual good botanical collecting that we do at the north and east. Species of *Opuntia* grow on the prairies in clay or sandy soil. *Solidago* and *Aster* have representatives, but not so many as one would expect to find here. The native species of Compositae are few as compared with the families Leguminosae and Gramineae. *Megapterium missouriensis* and *Ipomoea pandurata* occur in rather thin soil underlaid with sandstone. *Ipomoea leptophylla* occurs in the sandy soil along the Cimarron. The writer helped to secure one root of this species that was fifty inches long, but less than three inches in diameter at the largest place.

Some Common Autumnal Species of Edible Fungi.

C. L. SHEAR.

A warm, wet autumn is sure to afford abundant feasts for the mycophagist, and if one be so inclined he may lay in a winter supply in the form of catsup or of pickles or by canning them.

Armillaria mellea is usually to be found in considerable quantities about old stumps, and if collected when young it is very palatable. It is cespitose in habit and very variable in size.

The stem is usually rather stout and tapering at the base, bearing a ring near the summit. The pileus is convex or expanded, usually covered with sparse, minute, hairy scales. It is ochraceous brown in color, becoming paler with age. The pileus is commonly 3 to 4 inches broad, but frequently forms are found 6 to 8 inches across. It is possible that some of the things included at present may prove distinct species.

Hypholoma perplexum.—This plant is frequently referred to *H. sublateritium*, a European species. It is often very abundant and an excellent species for culinary purposes. It grows in dense cespitose masses about old stumps, apparently preferring oak. Sometimes a half-bushel may be found about a single stump. The stipe is rather slender, more or less flexuose on account of its crowded habit of growth, and usually has distinct traces of the cobwebby veil stained purplish-brown by the fallen spores, remaining attached near the summit. The pileus is broadly convex, somewhat fleshy, tawny-brown or reddish, paler near the margin, and 2 to 4 inches across. The gills are a light purplish-brown at first, becoming darker with age, and are attached to the stem. If taken when young this species is good prepared in almost any of the ways in which mushrooms are used. It is particularly good prepared with tomato sauce (see *Bulletin* for December, 1898, p. 107). Stevenson says of the European plant, *H. sublateritium*, "Taste very bitter; doubtless poisonous." But this certainly does not apply to our plant, which is pleasant to the taste when cooked, and has been eaten by myself and others in quantity without the least unpleasant result.

Tricholoma personatum.—This is another excellent species quite common throughout the east. It is called "Blewitts" in England, but I do not know that it has any common name in this country. It is a fine, large species, 3 to 7 inches broad, usually growing singly or scattered, in thin timber. The pileus is thick and fleshy, broadly convex or nearly flat, and a livid flesh color varying to violaceous gray. The stem is usually short, stout and rather firm, with a more or less bulbous base. The gills are rather broad, pale violaceous, and rounded behind or quite free from the stem. The best method of preparing this to suit our taste is to fry it in butter.

There are several other species of *Tricholoma* found in abundance in this vicinity. *T. terreum* is smaller than the preceding species, 1½ to 3 inches broad, fuscous or mouse colored with a short solid stem and ash-colored gills.

Tricholoma equestre, a species with sulphur-yellow gills, is intermediate in size between the two above-mentioned species. The pileus is pale yellowish, with minute fuscous scales. The stem is solid, sulphur-yellow, and also provided with scales. I have eaten it without any unpleasant effects, and found it very good.

Boletus brevipes occurs in large quantities in pine woods in late autumn, and is an excellent species for culinary purposes, though not very attractive in appearance when collected. It should be collected when young, and free from larvae. The pileus is rather thick and convex, dark chestnut color, fading with age and covered with a thick, tough glutinous layer, which should be peeled off before cooking. The pores are whitish at first, becoming dingy ochraceous with age. The stem is whitish and usually entirely without the brownish dots which are found on closely related species. There are several of these latter, but they are also edible.

Other edible species usually found in sufficient quantity for use are *Russula virescens*, *R. alutacea*, *Lactarius deliciosus* and *Hygrophorus hypothejus*.

Shorter Articles.

Further Notes on Talinum.

On August 2, of the present season, I examined several dozen plants in the field, on the sand dunes of Trempealeau prairie. In not a single case did I find a stem "tuberous at base." Some plants were as large as my garden plants, showing bunches or rings of leafscars below the live leaves, a character not found on my garden plants. These I interpret, not as signs of perennial duration, but as signs of dry spells during the present season; especially since these plants in all other respects are just like my cultivated plants, which are daily sprinkled with a hose.

It is, however, still possible, so far as duration is concerned, that this plant, in addition to its seed reproduction, may, under certain conditions, provide for its perpetuation by forming late in the fall the axillary buds or tubers observed on the eastern plant by Dr. Harshberger. To determine this I have planned to visit this Trempealeau prairie in September or October. The day on which I visited the locality was rainy and drizzly; in spite of this the flowers were fully open at 6 P. M., when thick clouds made it already quite dark.

J. M. Holzinger.

Among the Mycologists.

Dr. Underwood's book on Moulds, Mildews and Mushrooms has appeared, and will be a most valuable aid to the amateur. It will be indispensable to working mycologists in all parts of the country.

Captain McIlvaine, of the Philadelphia Mycological Center, has distributed advance sheets of a work on edible and poisonous mushrooms. The Captain is a veteran mycophagist, and a book from his pen will contain much of interest and value to the lover of the fungi. It is hoped that the price will be such as to place the work within the reach of all.

A mycological club was organized at Detroit, Mich., July 19th, of the present year. We welcome this new member to our circle of associations, whose purpose is the study of this interesting group of plants, and extend to the members of the club, as to those of others, the use of the pages of the *Bulletin* as a medium of publication for notes, news and contributions. The officers of the new club are as follows: H. C. Wisner, president; Dr. Rollin H. Stevens, vice-president and curator; Dr. Joseph

B. Sill, recording secretary; W. E. Riley, corresponding secretary.

Mr. E. B. Sterling, of the Philadelphia Mycological Center, has recently distributed separates of an address on "Toadstools" delivered before the "District Medical Society of the County of Mercer," held at Trenton, N. J., December 13th, 1898.

In the August number of the *Torrey Bulletin*, Prof. David Griffiths begins a series of papers on the Pyrenomycetes. There is need of a great deal of study on the North American species of this group before our knowledge of them is at all adequate, and we note with pleasure the appearance of another specialist devoted to them. In his present paper the author describes six new species, and records a number of others as being found for the first time in this country. The article is especially valuable for the cultural records contained in it, Mr. Griffiths having succeeded in growing a number of the species in the laboratory, securing some very interesting results. There is promise of rich reward in this line of research among the Pyrenomycetes, and it is to be hoped that the author will continue his studies in this direction.

The manna referred to in the history of the wandering of the Jews towards Canaan, is believed to be a species of small puffball, which is still found on the Arabian deserts, and behaves precisely as detailed in the Jewish history. Its botanical name is *Canona esculenta*. It is about the size of a pea, but comes out in such numbers as to be often in small heaps. It must be collected in early morning, as it dries up and disappears before night. It can, however, be kept for some time, if preserved from evaporation. It appears after heavy dews or rains that fall occasionally in the deserts. Nearly half its weight consists in nutritious matters, fit for human food—Meehan's Monthly.

Mr. C. O. Smith gives some interesting "Notes on the species of Agaricus (Psalliota) of the Champlain Valley," in the September number of *Rhodora*. Eight species have been found in the region thus far, and are described and discussed at some length in this article. The species reported are: *Agaricus arvensis*, *A. silvicola*, *A. comtulus*, *A. compester*, *A. rodmani*, *A. diminutivus*, *A. placomyces* and *A. silvaticus*. The first two are reported as abundant, the remainder less common, *A. silvaticus* being very rare, and *A. rodmani* local, though often abundant where found.

One of the most interesting autumnal genera of mushrooms, and one containing some fine edible species is *Lactarius*. The following species have been reported to the Washington Mycological Club as occurring in the immediate vicinity of that city: *Lactarius camphoratus* Fr., occurring in mixed woods September; L. *chelidonium* Pk., rather dry, open pine woods, September to October; L. *deliciosus* Fr., under pines, etc., October and November, edible; *L. indigo* Schw., in woods October and November; *L. piperatus* Scop., woods, October; *L. subdulcis* Fr., pine woods, a dark-colored form also occurs; *L. torminosus* Fr., damp woods, September; *L. volemus* Fr., mixed woods, September. Several species have also been found which seem to be undescribed.

E. M. W.

Notes from the Columbus Meeting of the A. A. A. S.

From a botanical point of view the meeting at Columbus was certainly a great success. As remarked by Dr. Britton, the sum of the papers presented at the Botanical Club, the Botanical Society of America and those before section G was greater than for any other science represented at the meetings, and bespeaks a widespread botanical activity in the United States.

A pleasant feature was the Sullivant memorial program arranged by the bryologists of the country. The workers in this field of botanical research are to be congratulated on the excellent showing of literature, typical specimens, etc., made at the meeting, and new interest and enthusiasm can not help but result. Dr. Bessey's suggestion that efforts should be made toward the establishment of a Sullivant fellowship at some of our leading universities or botanical centers is a good one, and will receive the support of botanists generally. The *Bulletin* will be glad to lend a hand, and offers the use of its pages for any discussions favoring the movement.

Much of the success, particularly in the Sullivant Memorial meeting, was due to the untiring efforts of Dr. Kellerman, of the Ohio State University. The beautiful souvenir specimens which he presented to each botanist attending the meeting will be mementos not only of Columbus and the "Sullivant Memorial," but also of a host who spared neither money, time nor energy in his endeavors to make the meeting a success.

We regret that our space will not permit us to publish the full report of the sessions of the Botanical Club, which has been sent us by Prof. A. D. Selby, Secretary pro tem. We have, however, selected items from the papers likely to be of most interest to our readers, and publish them in the following pages:

Lycopodium complanatum and the so-called variety *chamaecyparissus* were recently found in Vermont growing together, under exactly similar conditions, and a careful study of their essential characters shows them to be plainly distinct specifically. —Francis E. Lloyd.

During the dry season, when the supply of water is insufficient, causing the plants to wilt, the leaflets of *Cleome integrifolia* stand erect, instead of drooping, as is the case with most plants when wilted. This is undoubtedly a provision against the too rapid loss of water from the surface of the leaves.—Dr. Charles E. Bessey.

Lactuca saligna L., was discovered south of Dayton, Ohio, in 1898. It is clearly distinct from *L. scariola*, and may be recognized by its slender, twiggy growth, the absence of spines and other minute characters. This is apparently the first record of the species being found in the United States.—A. D. Selby.

A fourth station in Ohio for Lea's oak was discovered recently at Cedar Point, near Sandusky, Erie County. Two trees only were detected, and they were surrounded by many black oaks (*Q. velutina*) and still more numerously by the shingle oaks (*Q. imbricaria*). Other species of oak occur on the Point. The two trees were a few rods apart; their trunks were about twelve and twenty inches in diameter, respectively. The other stations known are Cincinnati, Brownsville, Licking County (the tree cut down in 1892, but sprouts from the stump are growing), and Columbus.—Dr. W. A. Kellerman.

The Arboretum and Botanic Garden of the Central Experimental Farm at Ottawa, Canada, was established in 1889. During that year 200 species and varieties of woody plants were planted in botanical groups. Additions were made from year to year, and by the end of 1894 the collection included about 600 different species and varieties. Since 1894 progress has been much more rapid and up to the present time the total number of kinds under test or which have been tested is 3,071. Of these 1,465 have been found hardy, 320 half hardy, 229 tender, 307 winter killed, and 740 have not been tested long enough to admit of an opinion on their hardiness. Where specimens pass the winter uninjured or with very slight injury to the tips of the branches only, they are classed as hardy. When killed back $\frac{1}{4}$ to $\frac{1}{2}$, half hardy; when killed to the snow-line, tender. A considerable collection of hardy herbaceous plants has also been brought together, consisting of about 1,100 species and varieties.—Dr. William Saunders.

News and Notes.

A recent number of Appleton's Popular Science contains an interesting article on "The Color of Northern Flowers," by Mr. John H. Lovell.

Subscribe for the *Bulletin*. Have your friends subscribe. Subscribe at once and receive the Journal until December 31, 1900, for the price of one years' subscription—50 cents.

Mr. T. J. Fitzpatrick, Lamoni, Iowa, is publishing a "Manual of the Flowering Plants of Iowa." Part I, containing about 75 pages, has already been issued. It deals with the Polypetalae, and is sold for 50 cents a copy. The work is gotten out by private enterprise and may be obtained by addressing the author, as above.

Prof. A. B. Seymour, who for nearly fifteen years, or since its establishment in 1885, has managed the business of the Cambridge Botanical Supply Company, has withdrawn his connection with the company, and the business will be continued under the management of Mr. E. P. Morse. Prof. Seymour will devote his time more closely to his botanical researches.

In a recently distributed separate from the proceedings of the Academy of Natural Sciences, of Philadelphia, Dr. John W. Harshberger gives some interesting observations on "Thermotropic movement of the leaves of Rhododendron maximum L." He found the leaves of this plant to react very rapidly to heat and cold stimuli, severe cold causing them to bend downward and to roll up tightly, exposing only the upper surface to the weather. When brought in this condition into a warm room they begin at once to unroll and assume a normal position. In either case the change of position takes place in from five to ten minutes. After studying the structure of the leaf and petiole Dr. Harshberger concludes that "turgidity is the main factor in the mechanism of these movements," cold weather setting the liquids in motion toward the upper surface of the petiole and leaf resulting in a downward flexure of the former and an inrolling of the latter, while the opposite result is produced by heat.

Among the various botanical separates and bulletins which have recently come to hand, the following are especially interesting and valuable: A Revision of the Western North American Phloxes, by Elias Nelson, in which a number of new species are described; The Histology of the Caryopsis and Endosperm of some grasses, by L. H. Pammel; Native Agricultural Grasses of Kansas, by A. S. Hitchcock, with graphic illustrations of the distribution of each species; Revision of the species of Lophotocarpus of the United States, by Jared G. Smith, with descriptions of new species; A Revision of the genus Sitanion, by the same author, describing some twenty new species; Structure of the Caryopsis of the Gramineae, by P. B. Kennedy; North American Grasses, II, by F. Lamson-Scribner, with illustrations of over 300 species.

Editoral.

The spirit shown by the botanists of the A. A. A. S., at the recent meeting at Columbus, during the discussion of the question as to the place of botany in the secondary schools and the best methods of teaching the subject, certainly augurs well for the future of the science in this country. There is scarcely a young teacher of botany who does not ask himself or others, with what particular subject and at what season should I start my class in botany to secure the best results? Can I give a thorough course in High School botany without a well equipped laboratory? The consensus of opinion expressed at Columbus, by such veteran teachers as Drs. Beal, Bessey, Kellerman, Barnes, and others, was to the effect that, given a well prepared teacher, filled with the "spirit of botany," it matters little whether the class begins in spring, summer, autumn or midwinter, whether the cell, cryptogam, or phanerogam is studied first. Well equipped laboratories are desirable, but not always absolutely necessary to a reasonably good course for the secondary school. The scope of modern botany is so wide and the "beginning points" so many that a teacher of the proper preparation and spirit will have no difficulty in finding plenty of material for study at any session of the year, and can employ profitably all the time that may be allotted to botany, even with a minimum of laboratory facilities. In fact, with the limited time usually allowed, any very extensive use of the compound microscope is hardly possible. This does not mean that school boards should not provide adequate laboratory facilities, but it does mean that great care should be exercised in selecting competent teachers. A man or a woman who has prepared to teach Latin, Greek, or history, and who is thoroughly imbued with the spirit of his or her specialty, can not be expected to secure the best results as a teacher of botany or zoology.

Recent Literature,

The recent paper on the "Hepaticae and Anthocerotes of California," by Dr. M. A. Howe, published as Volume VII of the memoirs of the Torrey Botanical Club, is an excellent example of the up-to-date monograph in systematic botany. The author is not content with work of the ordinary type, but has done much more than draw up mere descriptions of genera and species. The histology and morphology of the plants studied have been worked out with such a degree of care and accuracy that the monograph is a most valuable contribution to this phase of hepaticology, as well as to the systematic literature of the group. More than a dozen new species and two new genera have been discovered and described in the course of Dr. Howe's study of the Pacific Coast liverworts, and in all 86 species, distributed among 36 genera, are described in this work. The monograph is illustrated with 35 elegant plates and altogether is one of the best contributions to the literature of North American crytogams that has yet appeared, and we hope it will "set the pace" for future students in this line of botanical research.

In "Moulds, Mildews and Mushrooms,"* Dr. Underwood has given to American students of mycology one of the neatest and most useful "guides" ever written. He has, in a most satisfactory manner, accomplished the very difficult problem of compressing into the smallest possible space the greatest amount of useful information, and has at the same time written in an attractive, untechnical, readable style. Too often the writers of "guides" attempt too much and make their works unwieldy by including matter belonging more properly to the "manual." Dr. Underwood has avoided this error admirably and leads or guides the student to a pleasant acquaintance with the fungi and their literature, and then says to him: "Go on! there is the way, the plants, the literature; strike out for yourself." It is pleasant to have a "guide" with an up-to-date system of classification. Most of the English works of a similar scope and aim present such a jumble of families, orders, etc., that the student gets but little idea of the natural affinities of the plants themselves. A most valuable feature of the book lies in the copious footnote references to monographic studies, and the excellent bibliographies following the discussions of the orders. Another valuable and unique feature is the reference to collections and literature by States in chapter XI. Altogether American mycologists are to be congratulated that one of their number has produced such a work—alike useful; nay, indispensable to amateur and specialist. Now, let us have the monographic works on the various groups, that should follow the "guide." The publishers have done their part well in producing a neat, strongly-bound volume—with a few typographical errors, to be sure—but these can be corrected in the second edition. For we predict that the sales will be such as to demand another edition at an early date.

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*"Moulds, Mildews and Mushrooms," a guide to the systematic study of fungi and mycetozoa, and their literature, by Lucien Marcus Underwood, Professor of Botany, Columbia University. Henry Holt & Co., New York. Price, $1.50 net.

T. A. W.

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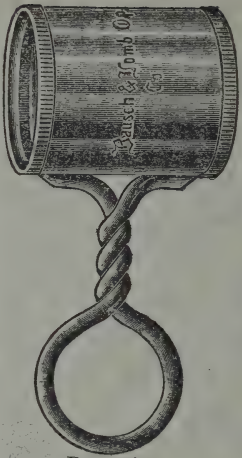
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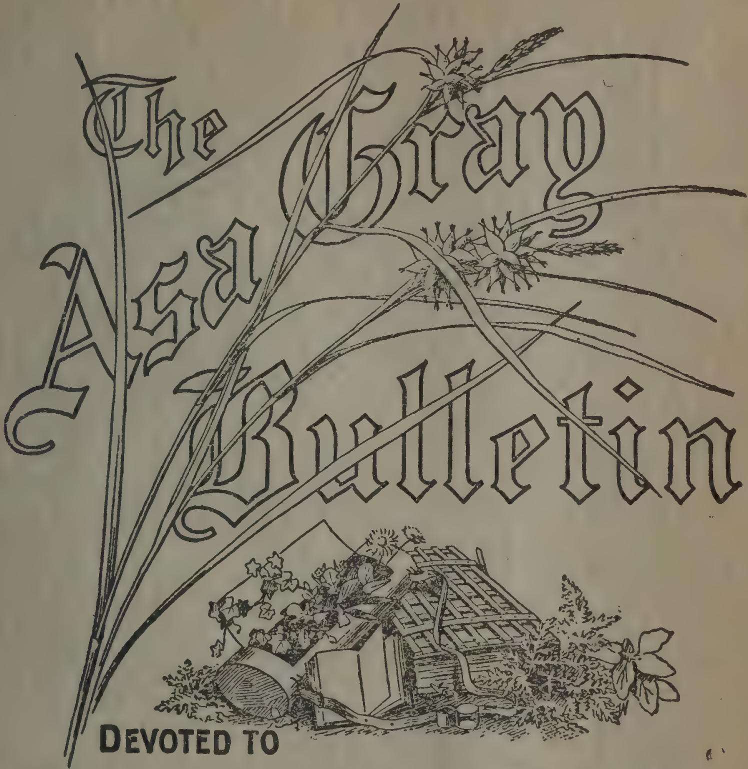
The Asa Gray Bulletin



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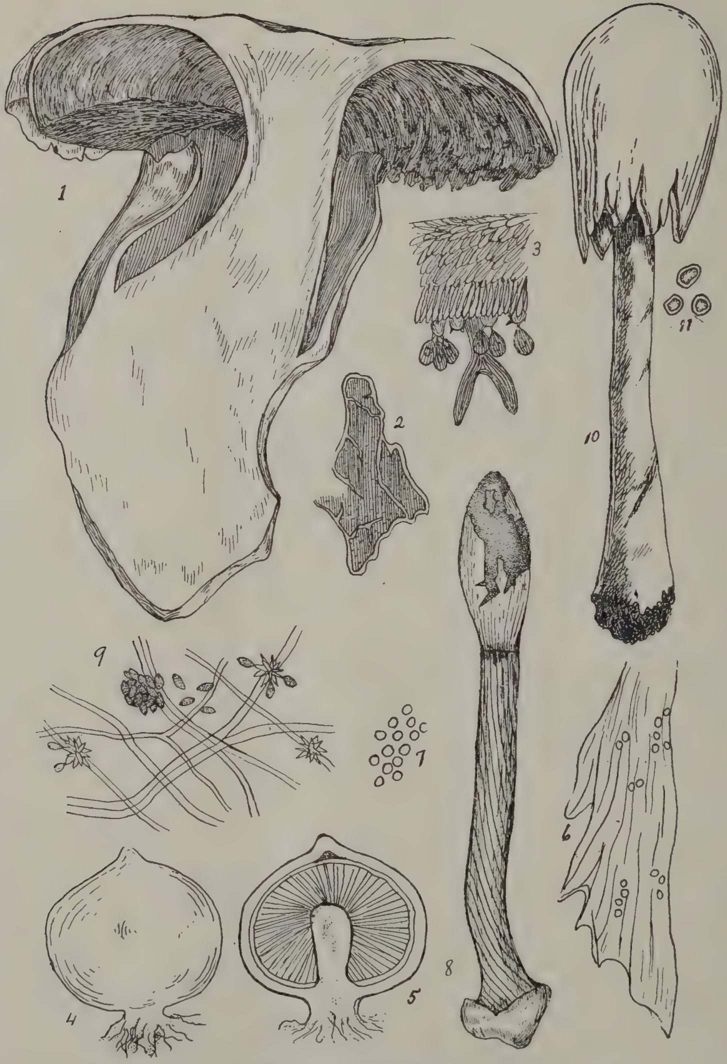


SHEAR ON PUFFBALLS.

Asa Gray Bulletin.

VOL. VII. NO. 6. DECEMBER, 1899. Whole No. 34.

Our Puffballs—II.

C. L. SHEAR.

In this paper we shall give a brief account of our genera and species of *Podaxineae*. This group, as here treated, is heterogeneous. The species are mostly rare, or not well known, and their life histories are little understood. We give them as found in Saccardo's Sylloge Fungorum. As before stated, it is not our purpose to attempt any revision of the classification of these plants, but to stimulate, if possible, an interest in the study and collection of them; as they must be better known before any thorough revision of them can be made.

PODAXINEAE.

Mostly stipitate, columella or stipe surrounded by the peridium; capillitium none, or sometimes copious. Columella extending to the apex of the peridium, except in *Cycloderma*.

SYNOPSIS OF THE GENERA.

1. Trama persisting in the mature plant in the form of an anastomosing membrane.
    a. Capillitium, none .... *Secotium*
    b. Capillitium present, filamentose .... *Polyplocium*
2. Trama disappearing at maturity, capillitium filamentose or floccose, attached to the columella.
    a. Columella free, not reaching the apex of the peridium .... *Cycloderma*
    b. Columella reaching the apex of the peridium.

* Peridium splitting on the sides or breaking away in fragments at maturity .... *Cauloglossum*

** Peridium splitting at the base about the stipe .... *Podaxon*

SECOTIUM.

Peridium usually stipitate, at first entire, rupturing at maturity by irregular slits about the lower part, furnished with a distinct central stipe which spreads out into the peridium at the apex; gleba spongy cellulose with anastomosing membranous septa; capillitium none.

1. **Secotium warnei** Pk. Peridium subglobose, ovate or somewhat elongate, squamose, whitish at first, becoming yellowish or brownish at maturity, sessile or short stipitate, rupturing about the base at maturity by 4-6 longitudinal slits; gleba white when young, soon becoming yellowish, then brownish, olivaceous; spores, subglobose or ovate elliptic, smooth, yellowish, 6-10 mic. long.

Peridium 2.5-10 cm. high, 2.5-7 cm. thick. (See Pl. II. fig. 1, A, B, C, D, E, *Bulletin*, Dec., 1898.) Pennsylvania to Nova Scotia, west to Western Kansas.

2. **Secotium texense** B. & C. Peridium ovate, ashy, membranaceous at the base; 3 cm. broad, gleba black; stipe ventricose, floccose, soon becoming tawny, about 7.5 cm. high, 18 mm. thick, attenuated upwards; spores globose, 5 mic. diam. Western Texas.

3. **Secotium nubigenum** Hark. Peridium 2.5 cm. or more broad, yellowish, smooth, irregularly depressed globose, usually subsessile, collapsing more or less when dry; gleba yellowish-brown; stipe very short, white, becoming yellowish; spores ovate, smooth, yellowish-brown, 6 x 8 mic. On trunks (decaying) of *Pinus contortus*. Sierra Nevada, Calif.

4. **Secotium decipiens** Pk. Peridium subglobose, 2.5-9.5 cm. broad, surface breaking up into loose appressed scales, cream-colored, lower part at first closely pressed to the stem, some-

times separating and forming a kind of annulus, sometimes splitting longitudinally; gleba lamelliform, variously united and anastomosed, forming irregular and somewhat labyrinthiform cells, free from the stem, almost or quite black; stem stout, 7.5-15 cm. long, 2.5 cm. or more thick at the base, abruptly narrowed at the peridium, solid, externally colored like the peridium, internally yellowish or rhubarb; spores globose or subglobose, smooth, black or brownish-black, 5-7 mic. long. Streets and lawns, Pasadena, Calif.

This is closely related to *Polyplocium*, and very near some of the Californian forms referred to that genus by Dr. Harkness.

POLYPLOCIUM.

The outer peridium volva-like, ample, coriaceous, rupturing about the margin of the pileiform inner peridium; gleba composed of somewhat irregular chambers more or less vertically arranged, the walls of the chambers arising from the hymenophore, the free portions split into large jagged processes; stipe distinct, stuffed, fibrous; spores black, mixed with scantily branched filaments.

5. **Polyplocium inquinans** Berk. Peridium 12-13 cm. broad, hemispherical, glabrous, areolate when dry; stipe gibbous below, 6.5 cm. thick, attenuated above, 2.5 cm. thick, 15 cm. long, soft, elastic; volva glabrous, 7.5 cm. broad, rupturing irregularly below, cupuliform, white; chambers of the gleba more or less vertically arranged; spores ovate, 1-2 guttulate, 4-8 mic. diam., reddish-brown. (Pl. VII. figs. 1-3.)

This species is reported with some doubt of the identification by Dr. Harkness from California. He says in some cases in the California plant the outer peridium does not rupture at all, but the gleba becomes exposed by the destruction of the stem by larvae. Corda says the gleba is blackish-brown when mature.

6. **Polyplocium californicum** Hark. Peridium grayish, soon rupturing and widely separated by the slender elongating stipe, which is 10-20 cm. long and 1-1.5 cm. diam.; pileus flat or depressed, 2-4 cm. broad; hymenium rusty-black, soon dusty;

spores dark reddish-brown, nearly globular, 6-8 mic. diam. Sand hills west of San Francisco, Calif., June.

CYCLODERMA.

Peridium of two layers, the exterior coriaceous, soft, the interior thin and papery; columella arising from the center of the base of the peridium, but not reaching to the apex; capillitium (trama) thin, radiating from the columella to the peridium; stipe none.

7. **Cycloderma ohiense** Cke. & Morg. Peridium coriaceous, subglobose, white, even, glabrous, umbonate above, fibrous-rooted at the base, 2.5 cm. or less in diam.; columella subcylindric, two-thirds the height of the peridium; capillitium (trama) white membranous, much folded and plicate; spores globose, hyaline, very small. (Pl. VII. figs. 4-7.) On the ground, Ohio.

The outer and inner peridium are said to be very distinct. The outer is composed of rather coarse, irregular, contorted fibres closely interwoven. The specimens upon which the description was based were so young that the manner in which the peridium ruptures was not observed.

CAULOGLOSSUM.

Peridium simple, clavate, continuous with the stipe, chartaceous fragile rupturing irregularly, enclosing the floccose columella which is a continuation of the stipe; capillitium intricate, branched; basidia (?) stellate-glomerate; spores simple, colored; stipe firm, erect, base clothed with the rudiment of the volva, which is incomplete and coriaceous.

8. **Cauloglossum transversarium** (Bosc.) Fr. Peridium large, persistent stipitate; columella conical. The whole plant is said to be 5-7.5 cm. high. (Pl. VII. figs. 8-9 represents another species, *C. aegyptiacum.*) We have seen no specimen or figure of the above plant, which does not seem to be very well known or understood. According to Saccardo, it has been found in S. Carolina and Florida.

PODAXON.

(*Podaxis* Desv. sec. Massee.)

Peridium subterranean and sessile at first, at length raised above the surface on a conspicuous stipe, dehiscing at maturity by splitting about the base and separating from the stipe, which passes through the peridium; gleba spongy, without distinct chambers or tramal-plates; capillitium abundant or almost wanting.

According to Massee, the spores in this genus are produced in asci, which can only be demonstrated when the plants are very young, and thus forms a sort of connecting link between the Ascomycetes and Basidiomycetes. The following descriptions are based mostly on those of Massee in his monograph in the Journal of Botany, 1890.

9. **Podaxon carcinomalis** (L.) Fr. Peridium oblong-ovate or broadly elliptic, 7-20 cm. high, smooth, becoming more or less fibrillose, lower margin becoming free and torn; stipe elongate, 12-40 cm. long, attenuated upwards, hollow, swollen at the base; capillitium dense, bright brown; threads thick-walled, simple or rarely branched, with distinct spiral markings; spores bright brown, smooth, elliptic-oblong, 10-12 x 6-7 mic. Reported from California by Dr. Harkness.

10. **Podaxon axata** (Bosc.) Peridium elliptical, 6-8 cm. high, smooth or fibrillose, becoming free at the lower margin and irregularly torn; stipe elongate, attenuate upwards, fibrillose and usually twisted, hollow, bulbous at the base, 10-17 cm. long; capillitium rare or obsolete; spores broadly elliptic or irregularly subglobose, thin-walled, dusky olive, with a brown tinge, 13-14 x 10-11 mic.

According to Massee, this is the older name for *P. loandensis* Welw., which is reported from California by Harkness.

11. **Podaxon farlowii** Mass. Peridium obovate-oblong, very obtuse, becoming free at the base and irregularly torn, 6-8 x 3-4 cm.; stipe elongate, 14-18 cm. long, subequal, stuffed, often twisted, slightly or not at all swollen at the base; gleba blackish-

brown; capillitium threads rare, with indistinct spiral markings; spores irregularly globose or broadly elliptic, smooth, dark brown, 10-12 mic. Pl. VII. figs. 10-11 (after Massee). Arizona and New Mexico.

12. **Podaxon mexicanum** Ell. Plant 4-8 cm. high; peridium ovate, 2-3.5 cm. high, 2-3 cm. wide, thin, white, clothed with broad, yellowish, appressed scales, attached to the stipe at first, then becoming free and lacerated; stipe tapering above, extending through the peridium to its apex, subbulbous, hollow, at first filled with silky fibres; capillitium of branching yellowish threads attached to the stipe or to the inner surface of the peridium, 3-8 mic. diam.; spores yellowish-olive, globose or ovate, 8-15 mic. long. Sonora, Mexico.

*EXPLANATION OF PLATE.—Figs. 1-3, *Polyplocium inquinans* Berk.; 1. median longitudinal section of a mature plant; 2. cross section of gleba, showing the chambers, somewhat magnified; 3. cross-section of the wall of a chamber highly magnified, showing the basidia and spores, also the stout filaments of hyphae, arising from among the basidia (after Corda). Figs. 4-7, *Cycloderma ohiense* Cke. and Morg.; 4. entire plant; 5. median longitudinal section, showing columella and the radiating membranous trama; 6. portion of the trama; 7. spores, highly magnified (after Cooke). Figs. 8-9, *Cauloglossum aegyptiacum* (Mont.) Corda; 8. entire plant, with portion of the peridium gone, showing the trama; 9. filaments from the gleba, with basidia (?) and spores, highly magnified (after Corda). Figs. 10-11, *Podaxon farlowii* Mass.; 10. entire plant; 11. spores highly magnified (after Massee).

Studies in Plant Physiology—IV.

BY DR. D. T. MACDOUGAL.

THE ACTION OF TUBERS AND BULBS.

Every species is represented by a number of individuals. Sometimes this number is very great, and may run up into millions, or even thousands of millions, as is the case with weeds, or algae or bacteria. On the other hand, but a few individuals of the species may be in existence at any one time, examples of which are to be seen in the rarer members of the flora. The life of the individuals may be a few minutes, hours, days or centuries, but if they do not constantly give rise to new individuals the species will become exterminated. Furthermore the new individuals must be produced as rapidly as the older ones die, or extinction will result. Modern examples of the extinction of species of plants are not common, although the earth's crust contains the remains of thousands which have existed in former geologic periods, and which have been unable to adapt themselves to the changing conditions of food and climate. Species are often reported to be extinct, but specimens will afterwards be found in remote or unexpected localities.

There are three principal methods by which new individuals may be formed; vegetative propagation, spore, and egg formation. Vegetative reproduction is the process by which a portion of the body of the parent is separated from the parent and made to replace the missing members. Thus the leaf of a begonia will replace the missing roots and stem when placed in moist sand, the stem of a willow will develop roots and leaves when set in a vessel of water, and the fleshy root of the sweet potato will grow the stem and leaves, though the root does not so generally share the power of propagation.

Seed-plants show various devices by which portions of the body are made suitable for propagation and severed from the body. Chief among these are tubers, bulbs, bulbils, corms, offsets, stolons, runners, suckers, besides the special structures exhibited by a few species only.

It will be both profitable and possible to make a study of the formation and action of the tuber and bulb even in the winter months, since examples are furnished by such common plants as the potato, onion, narcissus, and fleshy roots by the sweet potato.

Secure a dozen specimens of each of these structures from the soil in which they were grown; if too late in the season collect information as to the manner in which they were formed. Describe the origin of each.

Next make an examination of their structure. The onion will be found to consist of a number of coats or layers made up of sheathing scales enclosing a short, delicate stem in the center. Demonstrate this fact by cutting the onion in halves by a clean slice from top to base. Compare with the narcissus, which is also a bulb. The scales may not be closely applied as in the onion, and two or three bulbs may adhere. Make a section as before. Both the onion and the narcissus bulb are seen to be simply underground buds with thickened scales.

Examine the structure of a potato. It will be found to consist of a solid mass of tissue, with an outer corky layer, which shows several "eyes" or buds. It is a short, thickened stem, and each of the several buds are capable of giving rise to new individuals.

Examine the sweet potato in the same manner. No buds will be found, but the layer of growing tissue is capable or originating growing points from which stems are developed.

All of the above specimens are seen to be enlarged structures capable of growth in a manner that will give rise to a new individual. Some time is necessary for the new individual to develop absorbing organs and apparatus for food formation, and the effectiveness of these propagating bodies is greatly increased by the fact that they contain a large amount of food stored up for the use of the young plant. This is principally in the form of starch and sugar. The presence of starch may be detected by moistening the cut surface with iodine, when a blue color will result if starch is present. Do all of these organs contain starch? Test for sugar by taste. The fine powder which comes from sliced potatoes is composed of starch grains, which are small egg-shaped granules less than a hundredth of an inch in diameter.

Place two of each of the above structures in a hyacinth glass or in the top of a cup or tumbler containing water so that the base will be immersed. Place the preparations in a living room near a window, and note the action by which they produce new plants. What are the first organs developed in each case? How many specimens can a single onion, potato, sweet potato or narcissus produce?

Do all of the buds of the potato start into activity? If not, cut away those that do, and note the behavior of the sleeping buds. Where do new roots arise in each case?

Prepare a second set of experiments, but set them in a dark cellar or corner with a large tight box to exclude light. Make out all of the above points and describe differences due to the influence of darkness.

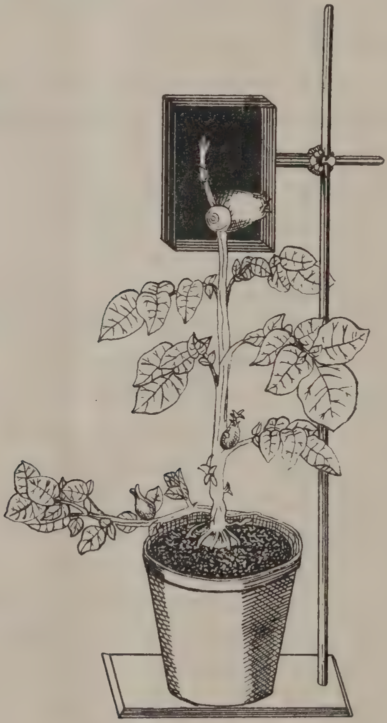
What is the color of the stems and leaves formed in darkness? Compare the length of the stems and the areas of the leaves.

It will doubtless be found that the stems of the potato and the leaves of the narcissus attain perhaps double their usual length. It is a common generalization in text books that leaves will not develop in darkness while stems show an exaggerated growth. The behavior of any member in the darkness depends upon its relations to the other members of the body, however, and upon the manner in which it unfolds or grows.

Thus when the potato tuber germinates in its natural position under ground the chief purpose of the stems is to push up through the soil and allow the leaves to be exposed to the light. The latter are not developed until the light is reached. In the germination of the narcissus bulb the leaves arise from short underground stems and push their own way up through the soil. Hence, in the two instances, a stem shows elongation in the one and the leaf in the other. What is the behavior of the sweet potato and onion?

The amount of food stored in such structures as the bulb of the narcissus and other tubers and bulbs is sufficient to form many stems, so that if the first crop is destroyed it can furnish the building material for many more, and it is thus able to make several attempts to reach the light. In almost all cases the plant does not develop the green color until it has reached the light, and is able to make use of it.

The potato tuber is an enlarged branch, and this plant has a habit of depositing starch in any branch which may not be exposed to the light, and converting it into a tuber. This is usually done with the short branches which arise from the base of the main stem, but it may take place in others also. If the plants are closely crowded together in such manner as to shade the stems, tubers may be formed on the aerial branches, or the same thing may occur as the result of a great amount of sugar and starch, more than can be accommodated in the underground tubers.



If a branch of a vigorous plant is run into a closed box and the leaves removed as soon as they bleach, the formation of a tuber may be observed. The experiment is best performed in the summer in the open air, and the box should be shaded so that the sun's rays will not heat it excessively. Some care is necessary for its performance. A strong wooden box or one of cardboard will be best suited to the work, and in order to be sure of good results several specimens should be treated in this manner at the same time. The accompanying sketch shows the manner in which this experiment is performed by Professor Vöchting.

Talinum Rugospermum, n. sp.

J. M. HOLZINGER.

Ever since July, 1888, when the writer collected this plant on the sand dunes of Trempealeau Prairie, there has been in his mind a suspicion that it was wrongly referred to *Talinum teretifolium* Pursh. This suspicion sprang from the statement in Wood's Botany, "Rhizome or perennial stem firm and fleshy;" the strong tap root of this plant did not seem to indicate perennial duration. In July, 1890, I collected it again at St. Croix Falls. And again the query as to the duration was left unsatisfied after careful inspection of the underground parts. Since then the matter has rested till two years ago, when I revisited the locality on Trempealeau Prairie. Somehow, I never succeeded in finding the flowers open. From the shriveled remains of such as I did secure I made out with tolerable certainty that, so far as number of stamens go, this plant might be *Talinum teretifolium.*

In the season of 1898, I transplanted a number of these plants to a sandy corner in my garden. Last spring, when I looked for perennating parts, I found not the slightest traces; everything had disappeared. Nor did I expect to see signs of vitality from the seeds. To my surprise, large numbers of terete-leafed seedlings sprang up over the area where the old plants had disappeared the fall before. How I watched the development and blooming of this plant was told in a note in a recent number of the Asa Gray Bulletin. When I discovered that its time of bloom is from 3 to 6 or 6:30 P. M., I saw the reason why I had never found it in open flower; it was always from 12 to 2 P. M. when I collected my specimens.

Prof. J. W. Harshberger, in his article on the genus *Talinum*, in the Torrey Bulletin of April, 1897, now furnished the hint for finding the next link in the evidence that we have in this Mississippi Valley plant a species distinct from *Talinum teretifolium.* Yet, even when I saw that the plant from Chester Co., Pa., differs as to time of bloom, the flowers opening from 12 to 3 P. M., it still seemed hardly credible that I was dealing with a new species. By the special kindness of Prof. Harshberger, I received alcholic material of the Pennsylvania plant, collected by himself. From this I was able to determine that there was certainly a difference in the anthers and style lobes. Not yet satisfied, I turned to Dr. J. N. Rose, of the National Herbarium, to get, if possible, some fruiting material of the Eastern plant, and it is through his courtesy that I was finally able to examine ripe seeds. He sent me part of a plant collected by Mr. J. McMinn, in Pa., part of Small & Heller's N. C. plant collected in 1891, and part of a plant collected on Dunn Mt., N. C., in September, 1897. The seeds of these three plants are alike, and differ strikingly from those of the Minnesota plant. The Dunn Mt. plant also had a flower, which shows that the shape of the anthers and style is constant.

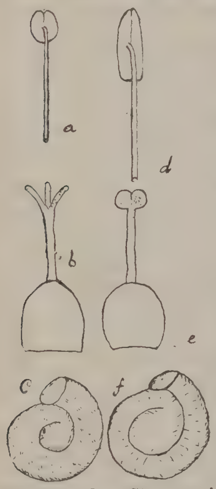


Fig. 1. *a, b, c,* Stamen pistil and seed of *Talinum rugospermum.*
d, e, f, Stamem pistil and seed of *Talinum teretifolium.*

Through the courtesy of Prof. D. A. Saunders, of South Dakota Agricultural College, I have been able to examine a Talinum collected by Thornber at Dell Rapids in August, 1892, and one collected at Custer by Rydberg in the same year. Both plants are referable to *Talinum parviflorum* Nutt. The markings on the seeds are very similar to those on the Eastern plants, as figured in Britton and Brown's Illustrated Flora.

At the present writing the geographical range of *Talinum rugospermum* is not fully ascertained. The only localities known are the one near St. Croix Falls, and the type locality near Trempealeau Mt. Doubtless, the plant has a wider range, and I shall be pleased to examine Talinum material from any part of the United States, partly with a view to settling geographical limits. The species may be designated and characterized as follows:

Talinum rugospermum, sp. nov.—Annual. Aspect of plant, inflorescence and flowers as in *Talinum teretifolium*, to which it has heretofore been referred. Sepals deciduous. Stamens, 12 to 25, with very slender, red filaments, bearing very short, yellow anthers, nearly circular in outline. Pistil with slender style, the latter split for about one-third its length into three slender stigmatic lobes. Seeds raised on a stalk which arises from the base of the one-celled ovary, hoary in gross aspect, under the pocket lens appearing rugose-warty.

As stated, the plant blooms from 3 to 6 P. M., the flowers opening but once, in sunny and cloudy weather. This, together with the shape of anthers, of style lobes, and markings of the seeds, well differentiates the plant from the true *Talinum teretifolium*, as will be seen by a glance at the accompanying figures.

Type locality: Trempealeau Prairie, Wis.

Type specimen in herbarium of State Normal School, Winona, Minn.

Shorter Articles.

Frost Flowers on Cosmos.

In the vicinity of Washington it is not an uncommon sight at this season of the year to see beautiful "frost flowers" on the common Dittany (*Cunila mariana*) early on almost any morning following a frosty night. Similar phenomena are recorded for a number of other plants, but so far as the writer knows, no one has yet reported the occurrence of "frost flowers" on the cultivated cosmos (*Cosmos bipinnatus*). For several mornings about the middle of November beautiful crystals of ice were observed issuing from the stem of this plant, a short distance above the surface of the ground. The crystals reached two inches or more in length and extended along the stem for about six inches. They were considerably thicker than those formed on the Dittany, but were more or less curled as in that species. The stem of the cosmos showed two large longitudinal ruptures on opposite sides from which the crystals issued. An interesting thing connected with this case is that the plant is an annual. The soil was well saturated with moisture and the plant had made a vigorous growth during the late summer and autumn.

Thomas A. Williams.

A Truffle from Maryland.

While digging some specimens of *Calostoma* a short time since in the pine woods at Takoma Park, Md., I accidentally unearthed a "truffle," which proved to be *Terfezia oligosperma* Tul. Further careful search revealed a few more small specimens. The largest specimen found was no larger than a hickory nut, so that the species would not prove of great economic value for food unless found in great numbers. The specimens were from one to two inches beneath the surface, and usually associated with the roots of an *Aster*. This, so far as I am aware, is the only species of *Terfezia* reported from the Eastern United States. *Terfezia leonis* has been found in Louisiana. This is a larger species than *T. oligosperma*, with larger, differently marked spores and more of them in an ascus. C. L. Shear.

Among the Mycologists.

In the October number of the *Botanical Gazette*, B. O. Longyear describes two new species of Agarics from Michigan—*Tubaria luteoalba*, related to *T. furfuracea* and *Galera crispa*, a species much like *G. lateritia*.

In *American Gardening* for November 11, Mr. Richard Maxwell describes a very simple method of growing mushrooms in the greenhouse. He grows them on the benches along with other plants, using the latter as a protection or shade for the mushrooms as well as to secure returns from the house while the fungi are getting started.

Among recent publications of special interest to mycologists are "The Fungal Flora of the Lehigh Valley," by Dr. William Herbst, the veteran mycologist, and "The Myxomycetes of North

America," by Professor Thomas H. Macbride, of the State University of Iowa. More detailed notices of these works will be given in a later issue of the *Bulletin.*

The meetings of the Pennsylvania Mycological Society are held weekly, and we welcome visiting friends or strangers who are interested in the study of fungi. It is surprising what a great variety of forms may be seen on the exhibition table, some common, others unknown and many of special interest because of their beauty, rareness or peculiar habit of growth. In spite of the fact that attention was called to the fungi of this region as early as 1763 by the enthusiastic botanist and collector, John Bartram, there is still so much to be learned regarding our fungal flora that it seems that we have only just begun to get acquainted with it. The society will devote a large part of the winter season to a systematic study of the structure of the Basidiomycetes. H. S. B.

The richness of the fungus flora of the District is well illustrated by the following: Two members of the local mycological society went out for a walk on the afternoon of the 25th. It was at Takoma Park. They walked slowly, both being out for pleasure and to gather only such things as might be easily found. In less than two hours they returned with a large market-basket full, and might have gotten ten times as much had they wished to do so. In counting up the species they found forty-four, besides a number of things so badly broken they could not be made out. A careful search over the same ground would probably have brought to light as many more, and yet the whole distance covered was not greater than four ordinary city blocks. At that rate it will be many years before field excursionists will find it necessary to go far to get all the material they can find time to work. E. M. W.

Recent Literature.

"Key to the Genera of Basidiomycetes of Vermont" is the title of contributions to the Botany of Vermont, VI, by Dr. E. A. Burt. This is an excellent key, and as the genera already found in Vermont include most of those in this country, it will be useful to all beginning the study of these plants. A most helpful and commendable feature of the pamphlet is a bibliography at the end, giving the principal literature relating to each of the genera mentioned in the key. With the keys now accessible to the student one ought to be able to become acquainted with the genera of the Basidiomycetes at least.

Dr. Burt has also recently published another paper on fungi in the Transactions of the Massachusetts Horticultural Society, Part I, 1898. It is entitled "The Resistance of Plants to Parasitic Fungi." The subject is discussed largely from an economic standpoint, and the various ways in which fungi gain entrance into their hosts, and the means with which plants are provided for resisting their entrance, are treated of. C. L. S.

Professor Ganong has done a service to botany in writing "The Teaching Botanist." * He gives most excellent instructions to teachers of botany for whom the book is primarily written, concerning the things most essential to good botanical teaching, the best methods of scientific recording and drawing, and botanical books and their uses. Professor Ganong has been very successful with his botanical classes, and under the caption, "The Place of the Sciences in Education and of Botany Among the Sciences," he states in a clear and philosophical manner his views as to the value of botany from a pedagogical standpoint. "It is essential," he states, "to the success of the teaching botanist that he have as clear-cut and objective a conception as possible of the place of his subject in Education." This the book attempts to supply.

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*The Teaching Botanist: A manual of information upon botanical instruction, together with outlines and directions for a comprehensive elementary course, by William F. Ganong, Ph. D., Professor of Botany in Smith College. New York. MacMillan Company, 1899; octavo, pp. xi, 270.

With teachers of science there has long been felt a want for a work dealing with the subject of laboratories and their equipment, and although a number of very valuable articles have recently appeared on this subject, yet, an authoritative work on the subject is still a desideratum. The author has in part supplied this need by incorporating in a chapter on "Laboratories and their Equipment," many valuable hints and suggestions, as to the erection and equipment of inexpensive laboratories. His views as to wardian cases, window gardens and apparatus are most opportune, and suggest possibilities to teachers in our primary and secondary schools, where an expensive equipment would be impossible. To the live and active teacher who may desire to set classes at work upon simple problems of plant morphology, ecology and distribution, the suggestions made by Professor Ganong as to botanical collecting are most valuable. Although the reviewer does not entirely agree with all the suggestions made in this valuable book as to methods, yet he feels that the book can be heartily recommended to those actively engaged in botanical teaching.

Since the appearance of Von Tubeuf's Pflanzen Krankheiten in English dress (translation by Smith) no work has appeared which compares in clearness and typographical "get up" to the recent book by Massee.* The book is intended primarily for practical persons, those engaged in plant growing and propagation. It also possesses considerable interest to the mycologist, because in a clear and concise manner our knowledge of the more frequent diseases of cultivated plants is given in a nutshell. Many of the more recently described diseases are included, so that the book gives a satisfactory resumé of the forms which are at present of interest. The short bibliography of each disease treated, and the soft-toned and yet accurate figures in the text add very much to the value of the treatise. It is especially gratifying that Professor Massee has done justice to American mycologists and their publications, as noted in the bibliographical details and in the description of a number of peculiarly American diseases. The book is to be recommended to students, farmers, nurserymen and plant lovers, who desire to obtain information concerning the most troublesome vegetable parasites.

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*A Textbook of Plant Diseases Caused by Cryptogamic Parasites, by George Massee, of the Royal Herbarium, Kew, London, Duckworth & Co.; New York. The MacMillan Company, 1899; octavo, pp. vi, 458, with figures in text.

Since the appearance of Coville's Botany of the Death Valley Expedition and of Coulter's Manual of the Botany of Western Texas, no publication from the National Herbarium has interested the writer in so general a way as the recent publication largely from the pen of Dr. J. N. Rose.* To the reveiewer, who visited Mexico in the summer of 1896, and has since published a number of articles on Mexican plant life, it appears that there is no more inviting field for tropical research than in the neighboring republic. Dr. Rose has brought together in this publication many attractive features. The illustrations are fine, and give pictorially the more noteworthy economic plants and their cultivation by the picturesque Mexicans, who are also included in the reproduced photographs. The text gives the scientific results of the several botanical trips which Dr. Rose has made to Mexico, and where he has collected extensively, either alone or in company with Mr. C. G. Pringle. Those interested in strange and useful plants would do well to procure a copy of this bulletin.

Nuclear Phenomena in Certain Stages in the Development of the Smuts, by Robert A. Harper, professor of botany, University of Wisconsin,† gives in some detail the appearance, formation and staining reactions of the nuclei of various of the smuts. A new method of staining the bacteria is suggested, obviating the possibilities of the distortion of the germ cells by the usual method of fixing and mounting. It is recommended for perusal to those interested in cytological studies.

Dr. John W. Harshberger.

University of Pennsylvania.

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*Contributions from the U. S. National Herbarium, Vol. v, No. 4, issued October 31, 1899.

†Reprint from transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. xii, pp. 475-498.

News and Notes.

Mr. A. A. Heller, of Lancaster, Pa., will start for Porto Rico about January 1st on a collecting trip, and will bring back a large collection of interesting plants from that island. He will pay especial attention to the collecting of mosses, lichens, fungi, and hepatics, in addition to making complete collections of the flowering plants.

Mr. C. G. Pringle has returned from his last collecting trip to Mexico with a good collection of choice plants.

Porto Rico is at present receiving more attention from American botanists than any other portion of the West Indies. Mr. O. F. Cook, accompanied by G. N. Collins and G. P. Gall, is engaged in a preliminary study of the plant products of the island, with a view to improving the agricultural conditions through the introduction of desirable plants for cultivation. The work is being carried on under the direction of the Secretary of Agriculture.

Professor Aven Nelson, of the University of Wyoming, spent the summer months in a thorough study of the flora of the Yellowstone National Park and the adjacent region. He made large collections of plants, and is now engaged in working up the results of his investigations.

Among recent appointments are: R. Kent Beatty, assistant in botany in Washington State Agricultural College; Wm. R. Maxon, assistant in cryptogamic botany U. S. National Herbarium; A. A. Hunter, botanical collector Nebraska State University; Louis W. Carter, special agent of the Department of Agriculture, in charge of the experiments with drought-resistant grasses and forage plants at the Cooperative Range Experiment Station at Highmore, South Dakota; Dr. Geo. W. Martin, professor of biology, Vanderbilt University.

Some of the recent bulletins on plants from the U. S. Department of Agriculture of special interest are: A Primer of Forestry (Bull., 24 Div. of Forestry), by Gifford Pinchot; Wilt Disease of Cotton, Watermelon, and Cowpea (Bull., 17 Div. Veg. Path. and Phys.), by Dr. Erwin F. Smith; Cereal Rusts of the United States (Bull., 16 Div. Veg. Path. and Phys.), by M. A. Carleton; Notes on the Forest Conditions of Porto Rico (Bull., 25 Div. Forestry), by Dr. Robt. T. Hill; The White Pine (Bull., 22 Div. Forestry), by Professors V. M. Spalding, B. E. Fernow, F. H. Chittenden and Filibert Roth.

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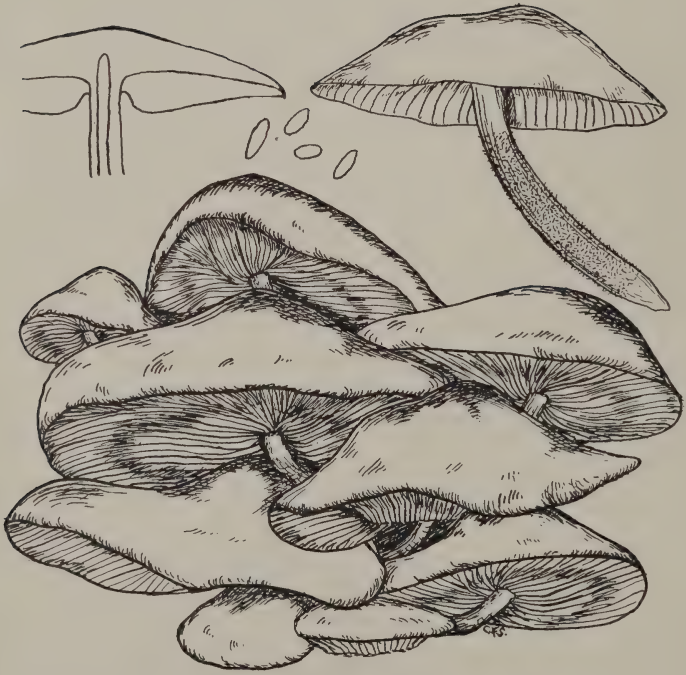

COLLYBIA VELUTIPES CURT.

Asa Gray Bulletin.

Vol. VIII. No. 1. February, 1900. Whole No. 36.

The Velvet-stemmed Collybia—Plate I.*

This season of the year, while rich in many things that are of interest to the mycologist, is rather barren of the fleshy fungi. A few, however, may be occasionally met with, and among them one of the most common is the Velvet-stemmed Collybia (*C. velulipes* Curt.). It is quite often found, and frequently in great numbers on prostrate trunks of decaying trees, even in the dead of winter.

It is easily recognized by its velvety brown stems, and is generally one of the first mushrooms an amateur learns to recognize at sight. The viscid cap of a much lighter shade of yellowish-brown, and the habit of growing in crowded bunches, often with twenty or more caps united together, make the plants quite conspicuous. It frequently happens that the tops are of a number of colors, shading from deep brown at the center to a very light yellow on the margin. This contrast of color with the still deeper velvet-brown of the stem is very pleasing, and an old log covered with these and other fungus growths, besides lichens and moss, makes a very pretty bit of winter scenery.

Professor Peck first called attention to its edible qualities in his report for 1897. The fact that when it does occur it is usually to be found in good sized bunches, and at a season when there is little else in the line of edible fungi, makes it of great interest to the mycophagist, though apparently its edible qualities are not well known. It is a plant of wide range and considerable abundance.

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*Collybia velutipes Curt.—Pileus rather thin, convex or nearly plane, obtuse, glabrous, viscid, reddish-yellow or tawny; lamellae broad, sub-distant, rounded behind, slightly adnexed, white or tinged with yellow; stem firm, externally cartilaginous, stuffed or hollow, brown or tawny brown, velvety hairy when mature; spores narrowly elliptic, 7.5-9 mic. long, and 4 mic. broad.—Peck, 51 Rep. N. Y. State Mus., p. 305.

One Thousand Miles for a Fern.*

DR. CHAS. E. BESSEY.

Eight years ago while collecting in the Black Hills of South Dakota I was told that Maiden Hair ferns grew at Cascade, about ten miles in a southerly direction from Hot Springs. Having studied the ferns of that region considerably, I had good reasons for doubting the report, but from time to time since then, this report has been repeated. During the summer of 1898 I received specimens of Maiden Hair fern said to have been collected at Cascade, but upon investigation, these specimens turned out to be not the common Maiden Hair fern of the North, but a Southern species (*Adiantum capillus-veneris*).

This confirmed me in my doubts as to the truth of the reports, as it seemed impossible that this Southern species should grow as far North as the Black Hills of South Dakota. More correspondence followed in which I was told that the specimens in my hands were actually collected at Cascade. Now, there seemed to be nothing for it but a personal visit to the alleged station of this fern—500 miles away.

Accordingly, late in August (23d), in company with Dr. Frederic E. Clements, I set out to find the station from which the specimens were said to have come. From the undulating and hilly prairies of Southeastern Nebraska with an elevation of less than 400 meters, where the forests form generous belts along the streams, we sped away northwestward, crossing the Platte River at an altitude of nearly 600 meters, after a run of less than 100 miles. We have just passed over the high and nearly flat divide separating the head waters of the Blue River from the broad flat-bottomed valley of the Platte, into which we make a sudden descent. Crossing the river, we make note of the many willow-covered islets which break the turbid mountain waters into numerous channels, and reach what is now the mainland, the original "Grand Island," having long since lost its autonomy by the obliteration of the North Channel. For twenty miles we run over the level surface of the valley, treeless, without a shrub, covered with tall blue-stem grasses, and crossing the spring-fed Loup River, we again begin the ascent of the long slope which stretches away northwestward to the foothills of the Rocky Mountains. As we ascend the Loup Valley, the trees are fewer in numbers of species and specimens, and when we cross the one hundredth meridian there are no trees in sight. Forty miles down the slope we passed the last Bur-oaks, small trees, evidently not old, and evidently advancing up the valley.

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*Read before Section G, A. A. A. S., Columbus, O., 1899.

We now enter the Sand Hills, with an undulating and often a rugged and almost mountainous surface configuration. These are not, however, hills of bare sand like those of the dunes of the coasts or of our great lakes, but they are covered with a short growth of deep-rooted grasses—bunch grasses and blow-out grasses—with many scattered shrubs and under-shrubs. For 150 miles we run through the Sand Hills, constantly rising in altitude, and emerge at last on the elevated Box Butte plains, 1,000 meters above sea level; not a tree, not a shrub greets the eye—only the gently rolling surface, covered over with a short growth of prairie grasses, mostly consisting of Agropyron, Stipa and Bouteloua. We rise rapidly and are soon in the foothills of Western Nebraska, where Pine Ridge attains an altitude of fully 1,400 meters. Here the Rocky Mountain Pine (*Pinus ponderosa scopulorum*) is abundantly scattered over the higher points and the slopes, while in the valleys and canyons we find a mingling of Eastern and Western species of deciduous trees. Now and then one may find xerophytic ferns of the genera Cheilanthes or Notholaena, and xerophytic mosses on the rocks, where one wonders how they ever get enough moisture to keep themselves alive. On the northerly slopes many streams issue from springs, and here mosses abound, and in the streams are dense masses of Chara and other hydrophytes. The White River plains lie beyond, and are often eroded into "Bad lands," where the vegetation, entirely xerophytic, is very sparsely scattered over the nearly bare ground. The Cheyenne River plains still farther beyond are not unlike those of the White River, and the two constitute a belt from 60 to 70 miles in width, in which xerophytic conditions prevail. Entering the borders of the Black Hills, the Rocky Mountain pines again appear, and with them other mountain plants. Grassy meadows with mesophytic conditions, and damp canyons with rich masses of hydrophytes are not unfrequent, showing a considerable amelioration of the quite adverse vegetative conditions through which we have passed. Still the vegetation is prevailingly xerophytic, until and after we reach Hot Springs. Here the high temperature of the waters (35 degrees C.—95 degrees F.) has given rise to the most profuse hydrophytic vegetation within the influence of these most favorable conditions. But Cascade is still ten miles away, and to reach it we drive out of the valley over the dry undulating foothills toward the borders of the mountain uplift. These foothills are studded here and there with small pines and the earth is covered with a low growth of xerophytic grasses, including Bouteloua, Bulbilis and Agropyron.

After a weary ride we suddenly drop down into a narrow valley, dry and parched, where we enter and soon pass a series of enormous springs from which gush such volumes of water that we now have at the roadside a rapid stream of clear water a couple of meters wide and 25 to 30 centimeters deep. The change in character of vegetation is immediate, and as we pass down the stream (Cascade Creek) there is a rapid accession of mesophytic and hydrophytic vegetation, with a marked accumulation towards the lower course of the creek. The water, where it emerges from its subterranean sources, has a temperature of about 25 degrees C., which it maintains for a mile or so in the creek, on account of the large volume of the springs and their nearness to each other. Here we found the long-sought Maiden Hair ferns, and it required but a glance to show us that they were not the Northern, but the Southern species. They fringed the borders of the creek, in some places growing up in dense masses and drooping over and dipping their feathery plumes in the running water. At no place were they found to have wandered away from the warm stream, although in several places there were conditions which seemed to be favorable and in which other plants with similar ecological requirements grew in great luxuriance.

We have found our ferns, we have vindicated the truth of the persistent report that Maiden Hair ferns grew in the Black Hills, and we have found that it is the Southern instead of the Northern species, but there remains still the question, "Are these ferns natives of this limited region, or have they been introduced?" It does not require a long investigation to show that if introduced, they must have been brought in a long time ago, much longer than the white man has been in the region. It is only about twenty-five years since it has been possible for white men to safely visit the Black Hills, and Cascade has been a place of resort (never much at the most) for less than ten years. The abundance of old and well-established plants extending from the springs down to where the creek opens upon the plains, is such as to preclude the supposition that they could have been brought here and transplanted by some fern-lover since the advent of white men. By what natural means they might have been introduced is a speculation upon which I do not at present care to enter. They are here, and here they maintain themselves. The warmth of the stream acts as a protection to them during the winter, and prevents their destruction by excessive cold. When the heavy snows fall they doubtless arch over the warm stream and enclose the tender ferns in a semitropical atmosphere, in which they pass the winter as safely as in a hot house. Probably for centuries these ferns have been here, and here they may continue to thrive if the hand of man does not materially change the environment.

As we walked up and down the warm stream we were led to inquire whether we may not have here a remnant of formerly more widely prevalent conditions. That there were ferns of this species at Hot Springs ten years ago is now certain, as I have a fragment of a plant collected there in 1891, and tradition tells of their once being abundant. I hope to take up this remaining question before long and may then be able to bring additional facts before you and to enter upon an explanation of this curious case of plant distribution.

We secured an abundance of specimens for distribution to the principal herbaria of the country. We rode out of the valley where a slight thread of warm water had brought an abundance of vegetable life, into the dry air of the foothills, where the fierce dry heat of summer, alternating with the bitter cold of winter, has reduced plant life to a short list of hardy xerophytes, and reaching Hot Springs, retraced our route across "Bad lands," plains, foothills, and sand hills to the green rolling prairies of Southeastern Nebraska, well pleased that our thousand mile journey had enabled us to settle one question, namely, the presence of the Southern Maiden Hair fern in this remote and unexpected locality.

Botanical Teaching in Secondary Schools.*

IDA CLENDENIN.

The discussion of botanical teaching in secondary schools by the American Association for the Advancement of Science, is something so unusual that an inquiry into its meaning is pertinent. Investigators are often too busy with the making of science to consider the presentation of it to boys and girls. An hour's time in a meeting of botanists offers great possibilities for discussing the virtues of killing fluids, the relative merits of stains, the meaning of the nuclear changes in the embryo sac. It requires some self-denial for the botanical section of the association to turn away from these and hosts of other interesting topics and take time to consider the teaching of botany in secondary schools. What, then, does their discussion of this question indicate?

First, it shows a recognition of the fact that botanical teaching in secondary schools is directly connected with the advancement of the science of botany. These schools furnish the material from which the university develops investigators. The attitude of young men and women toward botany, at the time they enter college means much for the future of this science. As the main factor in determining what this attitude shall be, botanical teaching in secondary schools becomes a matter of concern to the makers and lovers of botanical science.

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*Read before Section G, A. A. A. S., Columbus, O., 1899.

But as no science is an end in itself, the advancement of that science is not the question of greatest moment. Everywhere there is an awakening to the fact that instruction in any subject should develop in the child capacity for conduct. The botanist can not shirk, and does not wish to shirk, a share in the responsibility of training to good behavior. He believes that botany, rightly taught, helps to make good citizens. If he has not this faith, his right to spend his life in the advancement of the science becomes a matter of question. Enthusiastic advocates of the kindergarten point with pride to the fact that the penitentiary has never held a person who had the advantage of kindergarten instruction in childhood. It is not too much to hope that the independence of thought which comes from gathering facts first hand, and which the study of botany tends directly to develop, may claim a like intimate relation to the solution of the problem of good government. From the standpoint of its effect upon character and upon citizenship, the investigator has a direct interest in the nature of the instruction given to the boys and girls whose education ends in the secondary schools. His greater knowledge imposes upon him the duty of helping to shape this instruction aright, and his willingness to make the teaching of botany in secondary schools a subject for special discussion indicates that he realizes and accepts his responsibility.

In the short paper putting this subject before the botanical section of the association, I shall speak only of botanical work in high schools, and shall consider, first, the position of botany in the high school course; second, the time to be given it; third, the nature of the work that should be attempted in beginning the study of botany. These seem to me the questions that most need discussion, for a satisfactory answer to them determines whether botanical teaching shall accomplish the purpose for which it is designed.

In determining the position of botany in the high school course, the nature of the pupil's mind is the best guide. It should be given him when he is most eager for it. In his Talks to Teachers on Psychology, Professor James says: "Many of the impulsive tendencies ripen at a certain period, and if the appropriate objects be then and there presented, habits of conduct toward them are acquired, which last; but if the objects be not forthcoming, the impulse may die out before a habit is formed. In children we observe a ripening of impulses and interests in certain determinate order; later, these interests may wholly fade away. The proper pedagogic moment to work is when the native impulse is most acutely present. Crowd on the botany the moment you have reason to think the hour is ripe." Now the hour is ripe for work in natural science when the pupil enters the high school. He has not yet become introspective; his impulses are toward the outside world. Later, the serious problems of life present themselves; he begins to reflect on his place in the world and his relations to those about him; a more extended study of history presents man and his affairs as objects of highest interest. Interest in nature will not now be so easily awakened, if the earlier impulse toward it has not been met by intelligent instruction. The pupil should have science in the first year of the high school, and biology seems best fitted to meet the demands of his mind. He has a more acute interest in living things than he has in inanimate nature, and he can more easily comprehend the forms and activities of plants and animals than the formation of chemical compounds, the laws of falling bodies, or the causes of atmospheric disturbances. Biology is the science he should start with; it matters little whether it be zoology or botany that opens the course.

A second reason for placing botany early in the high school course is the fact that by so doing, more pupils receive instruction in it. An examination of the records of the Girls' High School, Brooklyn, shows that of those who enter the school about 30 per cent graduate. If no instruction in botany is given until the third or fourth year, one-half or two-thirds of the pupils leave school wholly ignorant of the science. From them a large part of the world's beauty is hidden away. This is no trivial consideration. What Huxley has said of the practical value of biological instruction applies almost equally well to botany alone: "It leads us to seek the beauties of objects instead of trusting to chance to force them on our attention. To a person uninstructed in natural history, a country or seaside stroll is a walk through a great gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of natural history, and you place in his hands a catalogue of those things which are worth turning around." If by placing botany early in the high school course, twice as many men and women can be given the desire to "turn the pictures around," botany should be placed there and should not be optional. The work need not be limited to this early course; some of the best high schools already provide for elective work in botany after an elementary course, and their number will increase, now that colleges and universities are beginning to recognize work in biology as worth something for entrance requirements.

Coming to a consideration of the amount of time botany shall have in the high school, the necessity of a compromise is apparent, unless great freedom of election is allowed. Zoology, physiology, botany, chemistry, physics, and physical geography are the sciences most widely claiming recognition in the high school course. If some work is required in each, it is plain that each can claim less time than if some of the subjects are entirely elective. At the risk of provoking adverse criticism, I venture the belief that the high school course which makes for the best all-round development is the course which requires of the pupil five months' work in each of the sciences named and provides for a year of additional work in the one which he prefers. This elective work I would offer in the senior year. The pupil would then bring to its pursuit the advantage of an elementary knowledge of allied sciences, and would form some adequate conception of unity in nature. The objection may be urged that these sciences train largely the same faculties, and it is, therefore, a waste of time to require all. They train the same faculties, but they do not deal with the same subject-matter. Training to habits of scientific thought is the primary aim of instruction in science, but a wide knowledge of the physical world has also its value for practical information. Four periods a week for five months of required work, and a year of elective work when laboratory facilities justify it, is the minimum time with which botanists should content themselves in the high school course.

In considering the nature of the work that should be undertaken in the high school, it would be ridiculous to discuss the merits of laboratory work, or the folly of trying to learn botany from text-books. These are questions already settled. There are still many schools without adequate botanical laboratories, but comparatively few in which, if botany is taught at all, laboratory methods are not employed in teaching it. The question is, rather, the merits of a course in gross anatomy, morphology, and general plant physiology compared with the merits of a course beginning with the single cell and proceeding systematically through types of the great groups up to phanerogams. The first requires little use of the compound microscope, the second demands its use almost constantly.

No matter what the merits of the two courses may be, nor how complete the laboratory equipments, if classes are large, hours short, and little time is allowed to arrange for laboratory work, the choice between the two should be easy. Against these odds no wise teacher will attempt a course requiring to any great extent the use of the compound microscope. He feels that it is inexcusable to do wholly inadequate microscopic work, when work in gross anatomy and physiology can be done excellently. He realizes that the pupil likes to accomplish something, and will lose respect for work that gets no results. He recognizes the fact that naked-eye work demands for the pupil less individual attention and offers vastly better opportunity to supplement insufficient time in class by outside observation and experiment. The pupil must be kept busy, and must be made to feel that he is doing something. I confess to full sympathy with the man who, in expressing his attitude toward the maxim, "Aim high, though you miss the mark," said he had rather shoot a Virginia squirrel from the fence than to shoot arrows at the sun all day. Some teachers prefer to "shoot arrows at the sun" because they have the notion that only microscopic work is scientific. They have respect for spores, chlorophyll grains, and the wonders of karyokinesis, but find no dignity in seeds, green leaves, and growth. They are willing the pupil should spend hours finding out the structure and function of the elaters of liverworts, but fail to see that the wings of the maple fruit, the hooks of the cocklebur, or the hairs of the milkweed seed are equally interesting contrivances for plant dissemination. They encourage the pupil to chase zoospores, or to watch the moving protoplasm in Tradescantia, but find no worth in simple experiments to show the giving off of oxygen by the leaf, the growth of roots toward supplies of food and moisture, or the course food takes in getting from the soil to the leaf. It is difficult to understand this attitude, and yet no inconsiderable number of teachers hold it. College and university professors of botany may be able to explain its origin. That they see its unfortunate effects, and are trying to change it, is evidenced by the character of the botanies for secondary schools, written by the head professors of botany in the universities of Michigan and Chicago. The worth of work in gross anatomy, morphology, and plant physiology can not be too strongly emphasized. A mistaken attitude toward it is responsible not only for much inefficient work, but also for the absence of botany from many high schools.

It now remains to consider which course is best to begin with when small classes, plenty of time, and ample room and equipments make conditions all that can be desired. The elementary courses in botany, in the schools of Indianapolis and Washington City, illustrate, though not perfectly, the difference of opinion on this question. The Eastern, Central, and Western high schools of Washington City offer as their elementary course in botany, work that occupies the last twenty weeks of a course in general biology, beginning, as such a course usually does, with the single cell, and ending with a flowering plant. This work is given in the last half of the third year. Following this is a year's work devoted mainly to the anatomy, morphology, and physiology of the higher plants. On the other hand, the Indianapolis High School offers in the last half of the junior year a course in gross anatomy, morphology, and plant physiology, then follows this with a year's work on typical forms, beginning with single-celled plants and ending with phanerogams. In the schools of the two cities named, facilities for botanical work seem equally good, and it might be added, almost ideal; in each ample time is allowed, and in each the laboratory equipments are better than in many good colleges. Any difference in the arrangement of the work must arise either from the feeling that the first work in botany should be fitted into certain zoological work that has preceded, or from an honest difference of opinion in regard to what the first work in botany should be; certainly not from the necessity of adapting the course to conditions. The botanical work in the Washington City schools is logically arranged, provided no student is admitted to the first course who has not done the zoological work of the preceding five months, but if the botanists in these schools were asked to give the first twenty weeks of the work in general biology, it is to be hoped they would show themselves as wise as the zoologists, who spend eight weeks on crustaceans and insects before they introduce Amoeba and Paramecium.

Whatever may be the nature of the greater part of the work, it is ordinarily best to start with something familiar as the surest means of arousing immediate interest and inducing outside observation. And whatever be the nature of the course, it should be broadened by intelligent supplementary work, for the benefit of those for whom the elementary course is the only one. If the basis of the work is gross anatomy, morphology, and general plant physiology, it should be supplemented by microscopic demonstration of the nature of the vegetable cell and cellular structure. On the other hand, if the work is mainly microscopic simple physiological experiments should supplement it in order to acquaint the pupil with the activities of the plant; the fact that the plant does something, and that he can make it do something, interests the pupil more than mere beauties of form and color.

Finally, the teacher may use or discard the microscope and still meet the aim of botanical teaching. This aim is primarily to teach the pupil to observe and to draw correct conclusions from his observations. Any course in botany which fails to do this, fails in the most important particular; it does not give the pecular mental discipline which botany is fitted to give. If at the end of a course in botany the pupil has no greater power of induction than he had when it began, except for the information he may have gained, he might better have given this time to mathematics, where "the facts are already in," and he has mainly to make deductions.

A second, and secondary, aim of botanical teaching is the increase of knowledge, the giving of information. A course in botany can hardly fail to do this, and yet, in getting away from the old-fashioned course which was purely for information, teachers sometimes lose sight of this aim; the teacher who gives the whole time to laboratory work, never taking an hour for questioning, has lost sight of it. Botanical facts are worth something for practical information; if not, botanists should give to zoologists the time botany asks in the high school course.

Lastly, botanical teaching should open to the pupil an inexhaustible source of "that pleasure which is derived from beauty," by bringing him to "nature out of doors as the real laboratory."

Girls' High School, Brooklyn, N. Y.

Some Woody Fungi.*

FLORA W. PATTERSON.

The so-called woody fungi comprise many conspicuous and attractive forms, which must have often drawn the attention of all readers of the *Bulletin* in their forest rambles. Although within the limits of this article nothing in the way of complete specific descriptions can be attempted, the general appearance of a few common ones may be given. All of those which we will consider belong to the *Polyporeae*, tube-bearing fungi. This family contains genera of somewhat diverse characteristics and many poorly defined species; but one most readily lending itself to amateur investigation, as determinations are mainly accomplished by superficial examination, and one may expect to be able to recognize genera at least without microscopical study. It includes forms that are resupinate, simple incrustations upon log or tree, and those whose fructifications of various colors, some minute, some of large size, project, bracket-like, from dead stumps or diseased trees.

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*Read before the Washington Mycological Club at its January meeting.

Every fungus is a plant and consists of a *mycelium* or vegetative portion composed of thread-like hyphae, and a *sporophore* or mature fruiting portion. In this family the part of the fungus having the form of pores is termed the *hymenophore*, and on the *hymenium* or lining of the walls of the pores are borne the spores, which are the principal organs for the reproduction of the fungus. The immense number of the spores is an example of the lavish scale upon which nature provides for the continuance of species. Their size is as the finest dust. The calculation has been made in an instance where the spores were not even very small ones, that it would require sixty-five thousand millions to cover a cubic inch of space. Methods for the dissemination of the spores are furnished by wind, rain, insects, birds, snails and other agencies.

Fungi being destitute of chlorophyll, the green coloring matter of plants, indispensable to the assimilation of carbonic acid gas from air, are dependent for their food upon the organic compounds of other plants or animals. They are classified according to their effect upon the host or the substratum upon which they exist as parasites or saprophytes. Parasites are those which obtain their food directly from living plants, and consequently act more or less prejudicially to the host. Saprophytes flourish upon a dead substratum and make no effort to penetrate living tissues. There are many examples of intermediate stages between those of perfect parasitism and complete saprophytism. Some species which usually live as saprophytes, may under certain favorable conditions, from a fungus point of view, become parasites of the most dangerous kind. True saprophytes living alone upon dead organic matter occupy a place of perhaps underestimated importance in the world's economy. By their agency the fallen leaves and debris of each season's growth undergo decay and are returned to the soil for its enrichment and the farmer is assisted by the gradual but certain disintegration of unwieldy stumps and logs. But far too often they attack valuable lumber in the yard, fence posts, railway ties, and timber in bridges and buildings, entailing heavy losses, and their development is often hastened by careless cutting, storage or methods of construction. Lumber dealers use descriptive terms of the fungus effects as dry rot, red rot, white rot, etc. A recent newspaper states that "dry rot" is slowly conquering the hitherto invincible frigate Constitution, which is at the Charlestown Navy Yard. The famous old vessel is still in the water with the hull protected by copper sheeting, and a house built over it, which is often opened and aired, but stanch timbers of live oak, once almost as strong as iron, while they still look firm, crumble at the touch.

The majority of the woody fungi could probably be best classified as hemi-saprophytes, capable of entire development as saprophytes, but as previously stated, owing to enlarged opportunities of favorable environment, changing to the flourishing condition of full-fledged parasites.

Fungus spores make their entrance into trees by means of some exposed surface resulting from wounds occasioned by broken branches, imperfectly protected surfaces after pruning, the gnawing of animals and boring of insects. The delicate germ-tubes from the spores are usually unable to penetrate the bark or even healthy tissues, but the way thus being opened, develop a mycelium, which, deriving nourishment from the injured parts, later attacks the living cells. Having taken possession of the interior of the tree, the fungus may remain long undetected, until, the mycelium having gradually extended towards the circumference, some chance is given by perhaps another wound, and it develops the sporophore on the exterior of the trunk, and thus completes the life-cycle. Before this fruiting stage has been reached the mycelium may fill cracks and cavities and form tough skin-like layers. An interesting example of a large growth of sterile mycelium is called *Xylostroma giganteum.* It is found in trunks of trees or logs, where it may form large masses, and sometimes between boards in lumber piles, where it forms sheets perhaps a foot in breadth and several feet long. It is very similar to white or soiled kid leather; indeed, the writer recently submitted a specimen for examination to a leather merchant, who unhesitatingly pronounced it of animal origin.

A strong selective power is possessed by spores of parasitic fungi. The germ-tube from a spore of *Polyporus betulinus*, the foe of birches, would never penetrate, even under the most favorable conditions of moisture and temperature, a pine or spruce; nor could one expect to find *Trametes pini* in an oak forest. But the germ-tube of a true parasite finding its suitable host, either actually perforates the cell walls, or by the excretion of its specific ferment produces a solvent effect, and certain disintegration of the tissues follows.

The chemical action of one species being entirely different from another, accounts for the varied appearances of fungus-infected woods. According to Hartig, the preeminent authority upon diseases of trees, "Every parasitic fungus that lives in the wood of growing trees destroys the wood in a manner peculiar to itself. When one and the same species of fungus, for example, *Polyporus sulphureus*, vegetates in trees of such different species as oak, willow and larch, it changes the wood so peculiarly in a short time that at first sight it is difficult to distinguish these timbers from each other, although in a sound state they are so strikingly different." The effect produced is termed the "red rot."

This *Polyporus sulphureus* is probably the most conspicuous of pore-bearing species. The brilliancy of its salmon or orange red sporophore with sulphur colored pores, and the habit of growing in dense clusters, make it very attractive. It is not particular in the selection of its host; almost any stump or log may serve as a habitat. The mycelium spreads through the wood, sometimes forming large sheets, and at a convenient season, coming to the surface, develops sporophores whose clusters may cover several square feet. Phosphorescence, in country parlance, "fox fire," is possessed in a marked degree by this species. Hawthorne reported the light from an improvised torch of mycelium-infected wood to have carried him safely several miles through an otherwise impassable forest.

Merulius lacrymans is the species which is the cause of a large proportion of "dry rot" in timbers. Its filamentous mycelium may take possession of the woodwork of a building, gradually decomposing it, although its presence may be unsuspected. Some part of the building in a situation protected from draughts finally furnishing the requisite dampness for a more luxuriant development, a whitish woolly growth appears, and later a brown roughened layer, sometimes forming tubercles or knots, upon which are borne the spores. It may also form cord-like strands that conduct water from damp parts of the building to dry timbers. When this moisture is not all absorbed it forms in drops or "tears" on the hymenium, which suggested the specific name. This fungus does not limit itself to wood, but spreads over surrounding objects, walls or earth, and in many instances the destruction of the pest offers a problem of difficult solution.

Poria vaporaria is an inconspicuous species owing to its sporophores being reduced to the lowest terms, viz., a simple stratum of light-brown pores. But it is responsible for much of the "red rot" of many kinds of timber, and as a parasite, is an enemy to coniferous trees.

An interesting wound parasite found upon fir, pine, spruce and larch is *Trametes pini*. Its sporophores are very hard, somewhat hoof-shaped, dark brown with concentric grooves; the rust-colored pores are sufficiently long to be called tubes. Young conifers do not suffer from fungus growths, for in the event of a wound, it is quickly rendered impervious to the attack of spores by an exudation of resin.

Having several years ago, at the request of Mr. Galloway, for a Government publication, made quite a thorough search for records of usefulness of fungi, other than as food, I found naturally, that those of actual service to man in the arts were by no means numerous or important. The results of that search were stated as follows:

Tinder fungus (*Fomes fomentarius*) is a parasitic growth upon various deciduous trees, and from it is prepared amadou, punk or German tinder. Its sporophores are bracket-like, hoof-shaped, dingy brown, thick at the base and attenuated toward the margin; tubes long, ash-colored; context or interior portion rather soft, compact, spongy, of a foxy rust-color.

This species and other large *Polyporeae* may be treated to form "Spongio lignine," or "soft amadou," which has the appearance of a pliable leather, and has been found valuable for chest protectors, hat linings, and various household purposes. The large pieces have even been sewed together for making dresses and coarse garments by some of the poorer inhabitants of Austria and Hungary. Badham (Esculent Funguses of England, 1863) says that several eminent surgeons of London used it extensively in their practice, preferring it to chamois skin on account of its greater elasticity. In America it has been largely employed by dentists as an absorbent. It is very efficient in stopping hemorrhages from cut blood vessels. Salmasius, a French scholar of the 16th century, thus described the process of its preparation for soft amadou. The fungus is to be first boiled, then beaten to pieces in a mortar, next hammered out to deprive it of its woody fibers, and, after being steeped in a strong solution of nitrate of potash, dried in the sun.

The razor-strop fungus (*Polyporus betulinus*) is found upon both living and dead birch trees. Its sporophores are from three to six inches broad, smooth, corky, elastic, hoof-shaped, with incurved margin; the upper surface covered with a brownish gray epidermis, which easily peels off; pores white or tinged with brown; context white. The whole plant when dry is very light.

The preparation of the fungus for razor-strops requires that it be cut in the autumn, when its substance has become dry and firm, subjected to pressure for twenty-four hours, carefully rubbed with pumicestone, sliced longitudinally, and pieces entirely free from the work of insects glued upon a wooden stretcher. The excellence of this material is probably due to the minute crystals it contains being sufficiently hard to act upon the steel.

Cesalpinus, an Italian physician and botanist of the 16th century, mentions this use of fungus growths, and the barbers of that period were familiar with it. *Merulius lacrymans* and *Xylostroma giganteum* also make excellent razor-strop material, propably requiring no preparation beyond care in the selection of suitably soft pieces.

Shorter Articles.

Maryland Plant Notes.

In lower Maryland, the "trumpet-vine" (*Tecoma radicans*) is variously known as "Virginia creeper," "poison oak" and "poison ivy," but stranger still is the name of "cow-itch."

Chimaphila maculata in one section is called "ground ivy," and has the reputation of being very poisonous to sheep.

In many sections the darkies use elderberries, sumac (*Rhus copallina*) for making wine, while "simmon beer" makes their eyes fairly dance. This is one use at least for persimmons.

Guy Stewart.

Maryland Agricultural College.

The Maximum Height of Some Common Plants.

An exact knowledge of the height to which certain plants may attain is important both from a practical and an ecological point of view, to say nothing about the requirements of scientific accuracy. While reading descriptions of some familiar plants in the manuals, the writer has often noticed the underestimate in regard to height and size of parts. Gray's Manual is far from the truth in this respect, the measurements given very often representing only the dwarfs of the species. Britton and Brown's Manual is more accurate; yet no one can suppress astonishment at some of the figures given.

During the summer of 1899, in Clay County, Kans., the writer made a few measurements of the common tall species at hand. The results are given in the table below in comparison with Gray and Britton, and need no further comment, except that they seem to show the necessity of considerable work still to be done in this direction.

Here is a line of work that could be largely done by our young botanists. Both the maximum and minimum height of a species should be ascertained, and, of course, the species should be identified by some competent systematist.

	GRAY	BRITTON	MEASURED
	FEET	FEET	FEET
Spartina cynosuroides (L) Willd	6	6	10
Panicum crus-galli L	4	4	7⅛
Panicum virgatum L	5	5	7⅔
Andropogon furcatus Muhl	4	6	8⅓
Chenopodium albidum L	4	10	11
Chenopodium hybridum L	4	4½	9½
Amaranthus hybridus L	....	8	11
Polygonum pennsylvanicum L	....	3	6⅔
Euphorbia marginata Pursh	3	3	6
Verbena hastata L	6	7	8
Verbena stricta Vent	2	2½	7
Ambrosia trifida L	12	17	20¼
Ambrosia artemisiaefolia L	3	6	8¾
Helianthus doronicoides Lam	7	7	12
Helianthus petiolaris Nutt	3	3	8
Helianthus annuus L (wild)	....	6	17

Ohio State University. John H. Schaffner

Field Observations on Talinum.

After my experience with the Mississippi Valley Talinum it becomes apparent that this genus needs to be studied more closely in the field. Prof. Harshberger's generalization that "the time of opening of the flowers in these plants is specific," being from 12 to 3 P. M. for the Atlantic States Talinum teretifolium, and from 3 to 6 P. M. for the Upper Mississippi Talinum rugospermum, needs to be tested on the remaining Talinums of our domain. When do the flowers of Talinum calycinum, and of Talinum parviflorum, open? and, How long do they remain open? are questions that await answer at the hands of those that are favorably situated, either to observe in the field, or bring the plants by seeding or rootstocks within reach of a number of daily observations. The same holds for Talinum humile, which seems to me not necessarily "one of those species whose flowers open at evening and close in the morning;" for Talinum rugospermum blooms later than 2 P. M., and yet its flowers are closed before 7 P. M. I urge especially that in each case a number of flowers be taken separately while in full bloom, and pressed promptly between bits of folded tissue paper. Ripe seeds also need to be secured more abundantly than are usually found on our herbarium specimens of the species of Talinum.

John M. Holzinger.

Among the Mycologists.

In the Torrey Bulletin for December, Professor F. S. Earle has an article on "Some Fungi From South America," based on a small collection made by Professor C. F. Baker in 1898, near Santa Marta, U. S. of Colombia. A number of new species are described, including two species of Uredineae, named by Dr. P. Dietel.

Bulletin No. 10 of the Boston Mycological Club, a glossary for the students of fleshy fungi, is a pamphlet that will be highly prized by all students of these plants who make its acquaintance. Those who are not members of the club may obtain it by sending 25 cents to the treasurer of the club.

The Pennsylvania Mycological Society devoted the time at its last meeting to a discussion of the "Porphyrosporae." During one of our collecting trips, after gathering some fine specimens of *Pleurotus sapidus*, an Italian whom we met eyed the much-coveted prize and said he had gathered basketfuls in his native country, and it was good! good! A large *Hydnum erinaceum* found in the fall of 1899 near Salem, N. J., measured thirty inches in circumference, and weighed five and one-half pounds, after being kept several days. H. S. B.

In the January number of the Torrey Bulletin, Professor Peck describes a number of new species of fungi, among them two from this part of the country. One, *Stropharia irregularis* Pk., was collected at Linden, Va., last August; the other, *Lepiota rugulosa* Pk., is not uncommon on moist, grassy lawns in and near the city of Washington. It is a very small and dainty fungus, and when fresh is so frail it can scarcely be handled. After it dries, as is often the case with the Lepiotas, it becomes tougher and makes a very pretty, though minute, herbarium specimen.

The Genus Psalliota is the subject of a pamphlet sent out recently by C. G. Lloyd, and bearing the date of November, 1899. It is full of useful notes, as his pamphlets usually are, and since the genus under consideration is the one which contains our common edible mushroom and related species, it will probably be the most used of all the pamphlets sent out heretofore. Thanks to the author's generosity, it is to be had for the asking, and with the excellent photographs which may be obtained at cost, by sending to the publisher, it adds another to the necessary papers for a mycological library.

E. M. W.

Dr. P. Hennings in Notizblatt Des Königl. Botanischen Garten und Museums zu Berlin for December, 1899, gives an interesting account of several edible fungi extensively used by the Japanese. Three of the most important sorts are "Shiitake" (*Cortinellus shiitake*); "Chiratake" (*Pleurotus ostreatus*), and "Matsutake" (*Armillaria edodes*). Both "Shiitake" and "Chiratake" grow on decaying wood, and are extensively cultivated for food by the Japanese. "Matsutake" is said to grow in the earth in pine woods, and is highly prized for its edible qualities. It is said that the annual crop of "Shiitake" amounts to more than $25,000. Dr. Hennings also mentions another fungus which is eaten under the name of "Sioro," a species of Rhizophogon (*R. aestivus*), and a lichen (*Gyrophora esculenta*), known as "Iwatake," or rock fungus, which is also greatly prized for its edible qualities.

T. A. W.

Recent Literature.

"Minnesota Plant Life" is the title of Prof. Conway MacMillan's very attractive volume published as No. III, Botanical Series of the Natural History Survey of the State. The natural orders of the vegetable kingdom, from lowest to highest, are treated in a popular and attractive manner. The author tells us that the book is intended for the intelligent men and women and boys and girls of Minnesota who wish to know more about plants. The book is intended primarily for distribution to the people of the State, and will surely do much to stimulate and increase an intelligent interest in the phenomena of plant life. The work is profusely illustrated with artistic as well as instructive reproductions of photographs. It is a book which should be in the hands of every teacher of botany, especially those in the public schools, as a source of inspiration and illustration, but not as a text-book.

C. L. S.

The report of the New York State botanist for 1898 has recently appeared. In it Prof. Peck reports forty-six species new to the herbarium collected within the State, among which are several new species and varieties of fungi. Under the heading "C" are given in parallel columns the New York species according to the nomenclature of Gray's Manual and the equivalent as found in Britton & Brown's Illustrated Flora. There is also a list of the plants of the summit of Mt. Marcy, preceded by an interesting account of the physiographical features of the place. The final portion of the report is devoted to descriptions of twelve additional species of edible fungi, accompanied by quarto colored plates, uniform with the ones previously issued.

C. L. S.

A recent work dealing with a local flora, but which is of much more than local interest, is Dr. Wm. Herbst's "Fungal Flora of the Lehigh Valley." For more than twenty years the author has studied the fungi of this region and we here have the results of his industry. The work contains a large number of illustrations made from photographs by the author, which although not always of the highest artistic finish, are full of character and thus truly useful to the working mycologist. One of the best of the illustrations is that of Sparassis herbstii, a species discovered by the author after whom it was named by Prof. Peck. Throughout the book one can catch glimpses of the personality of the author and of his great love for the plants to which he has devoted so much of his time. The work will be found useful to all students of mycology in the eastern United States, particularly so far as the fleshy fungi are concerned.

T. A. W.

One of the recent publications of the Department of Agriculture of especial interest to teachers and field botanists is "A Primer of Forestry," by Gifford Pinchot, forester to the department. While the work is intended primarily as an elementary treatise for those especially interested in the subject of forestry, it is nevertheless of great interest and value to all lovers of the field and forest. The work is profusely illustrated with photographs from nature, showing the habit of growth, and other characteristics of the important native forest growths, and as the author says in his preface, deals with the units which compose the forest, with its character as an organic whole and with its enemies. This is one of the books that should be in the hands of every public school teacher, as well as the practical forester, and is an example of the excellent work now being done at the Department of Agriculture in economic botany.

E. M. W.

In a recent number of Minnesota Botanical Studies, Professor Bruce Fink has two articles on the Lichens of Minnesota; one on the Lichens of the Lake Superior Region, the other on Lichens of the Minnesota Valley and Southwest Minnesota. In both of these articles Professor Fink devotes considerable space to the distribution of the species with reference to the various substrates upon which they are found. The discussion in the second article is especially noteworthy since it is the first attempt of an American botanist to give an extended account of the lichens of a particular region with reference to the principles governing plant formations. After a careful study of the lichens of the region in question, the author has been able to recognize a number of lichen formations, and his discussions of the various species composing them and their relations to one another are interesting and instructive. He has met with considerable difficulty in the selection of suitable designations for the various formations, but has nevertheless succeeded in making an excellent presentation of the facts obtained. One new species and two varieties are described in the articles, and a large number of species are reported from Minnesota for the first time.

T. A. W.

Observations on the Colors of Flowers, by E. Williams Hervey, is a recent work of much interest to plant lovers. The author's views on the derivation of color in flowers are in many ways unique, and are generally opposed to those of Mueller and Grant Allen, perhaps the two foremost writers on this subject of recent years. The work contains much food for thought, and should incite further investigation, although it is hardly probable that all will agree with the author in his line of reasoning or in his conception of what constitutes a primitive flower. The chapter on "Honey Guides" is especially interesting, and the author's explanation of their origin and function is unique.

T. A. W.

News and Notes.

A new journal of popular botany has been started under the auspices of the New York Botanical Garden. It will be edited by Dr. D. T. MacDougal, director of the garden laboratories, whose well known energy and talent will insure to it a successful and useful career.

With the December number the editor of Erythea announces the discontinuance of that journal. This is certainly to be regretted, since it has so long represented the botany of the Pacific slope, which will thus be without a good botanical journal.

The officers of the Gray Memorial Botanical Chapter for the year 1900 are: Jas. A. Graves, president; Wm. H. McDonald, general secretary; Geo. P. Ells, treasurer; John A. Wheeler and S. C. Wadmond, executive committee. The division secretaries are: John C. Buchheister, Division A; Wm. C. Barbour, Division B; O. A. Farwell, Division C. Any information concerning the chapter may be had on addressing Jas. A. Graves, Susquehanna, Pa., or Wm. H. McDonald, 122 Pearl Street, Elizabeth, N. J. A Correspondence Bulletin is issued each month, except in August and September.

At a recent meeting of the Board of Trustees of the University of Wyoming, the herbarium connected with that institution was officially recognized as The Rocky Mountain Herbarium, and Prof. Aven Nelson of the university was named as its curator. In order that this collection of plants might be more definitely designated than heretofore, it was deemed advisable to distinguish it by some descriptive name. The above was chosen because it expresses the purpose of those who are endeavoring to build it up, viz: to make it an accessible and serviceable collection of the plants of the Rocky Mountains. It is established on such a basis as to insure its permanency, and it is hoped that it will find among the botanists of the mountain States so many friends as to insure its rapid development.

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Fig. 6. Noonday position of the leaves of the sensitive plant.

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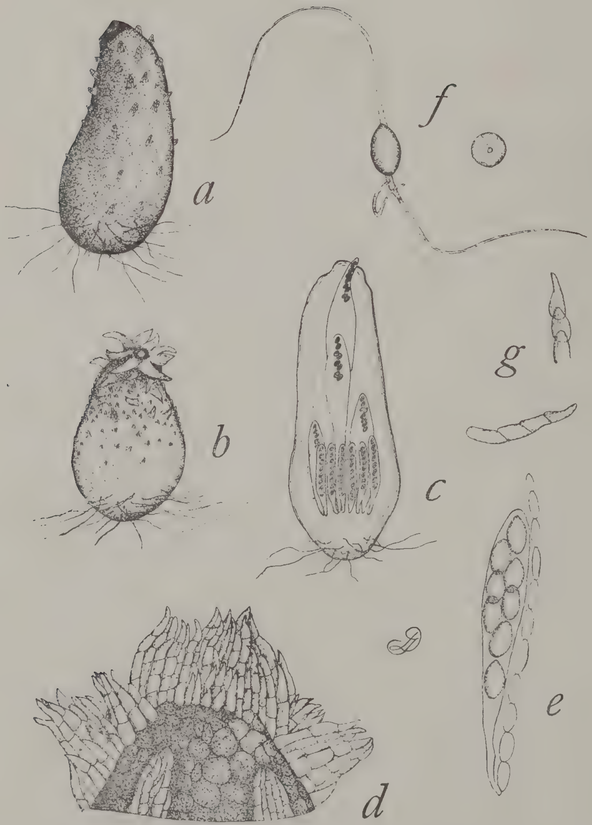

GRIFFITHS ON SPORE DISSEMINATION IN PODOSPORA.

Asa Gray Bulletin.

VOL. VIII. NO. 2. APRIL, 1900. Whole No. 37.

A Study in Spore Dissemination—Plate II.

DAVID GRIFFITHS.

Every teacher of botany and every student of nature has carelessly plucked the scape of the dandelion and blown off the seeds to see how far the breeze would waft them, has watched the ripened pod of the oxalis to see how far the seed would "jump," has gathered a handful of "needles" of the porcupine grass (*Stipa*) and thrown them at a friend, or has watched the fruit of the wild oat "crawl" as it dried on his hand in the sun. He may or may not as a boy have realized that he was observing one of the most important phenomena of plant life—that of seed distribution; but with maturer years he has come to realize the meaning of all of these phenomena, and has come to recognize a host of contrivances which the different plants of his acquaintance adopt for the dissemination of their seeds.

While the above are matters of common observation, simply because they can be detected by the unaided eye, they are no more unique than the methods adopted by some of the fungi for the distribution of their spores. It is the purpose of this article to call attention to a method of spore distribution in one group of the *Sordariaceae*, a family of *Pyrenomycetous* fungi. Certain species of this family are particularly favorable objects for the study of spore distribution, because the wall of the conceptacle (perithecium) in which the asci are produced is transparent enough to enable one to see what is going on within it.

The greatest difficulty in the way of studying this phenomenon is connected with securing the plants. This is neither an easy nor a pleasant task; but since we are all willing to work for the sake of becoming acquainted with new phenomena and learning new truths, we will succeed.

As stated, the first task is to secure the plant. Since this group of organisms grow generally on the manure of herbivorous animals, it will be necessary for us to collect some of this substratum and place it under suitable conditions for the development of these fungi. The best way is to collect small quantities of old dry dung of horses and cattle from pastures. Each sample should be placed in a moist chamber, which can be improvised from a plate and a bell jar or a large tumbler and saucer. Of course a stentor or large Petri-dish is the most satisfactory; but if these are not at hand, such a moist chamber as mentioned above can easily be improvised. The substrata thus collected are simply kept moist (not wet) and allowed to stand in a place which has a temperature about like that of an ordinary living room.

It would be a very strange thing indeed if one did not find before the end of the fourth week, one or more species of the *Sordariaceae* in each of the cultures thus prepared. There are several species, any one of which will serve our purpose. Among the best are *Podospora curvula* and *P. minuta.**

As these are common throughout the eastern part of the United States it is not usually difficult to secure one of them. The fungi will appear in the cultures in from three to five weeks. Others may appear in eight days and still others not before a month has gone by. Indeed several species may be found on the material as collected in the field, but they will not usually be as good for study as those grown in a moist chamber under favorable conditions.

To save further trouble, after a good vigorous crop of either of the above species has once been secured the spores can be saved from year to year and new cultures may be made at any time. A very good way to get a quantity of spores in good condition is to take the material with the fresh mature perithecia on it from the moist chamber, and support it in some convenient way over a piece of white paper. The paper should be first heated for an hour in an oven at the temperature at which bread is baked or as hot as it will stand without being scorched. This is done to kill mould spores. This paper placed carefully under the inverted culture with a bell jar or tumbler over it for several hours will catch a quantity of the spores. In mass these can be readily seen with a hand lens. Great care should be exercised to keep the spores as free from contamination with mould spores as possible.

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*The reader is referred to Ellis & Everhart's North American Pyrenomysetes, Saccardo's Sylloge Fungorum, or Rabenhorst's Cryptogamen Flora for descriptions of species. The two species discussed in this paper can be easily recognized by the accompanying figures and by their peculiar fasciculate hairs. DeBary's Morphology and Physiology of the Fungi, etc., will also be very useful.

New cultures can be made by sterilizing a piece of blotting paper, and moistening it with a decoction of any old dead herbage—dead leaves, straw, or even water from boiling potatoes. Decoctions made in this way should be boiled for twenty minutes on three successive days and kept carefully corked all the time with a plug of cotton. A Petri-dish is the best thing to make a culture in. In making the culture a small piece of the paper with the spores on it is simply laid on top of the moist blotting paper.

Suitable material for study having been obtained and a crop of spores harvested for future sowings, a critical examination of the method adopted by the plant for scattering its spores may next be made. But in order to do this it is necessary to have a good understanding of the structure of the perithecium.

It is very difficult to tell much about the early history of the perithecium from material which is growing on the natural substratum; but, if a culture is made as stated above, one can see that the perithecium begins as a minute thickening on the mycelial strands which cover the paper. In some species the perithecium grows below the surface for a long time and in the two species under discussion (*Podospora curvula* and *P. minuta*) it begins development beneath the surface. For the best observation of the earlier stages it would be better to make cultures on agar-agar if facilities for such work are at hand.

If a half-grown perithecium is mounted and examined under a compound microscope it will be entirely colorless and globular in outline. The apex will be made up of the ends of short, free hyphae. When pressure is placed on the cover glass, a mass of tissue will escape, which consists mainly of paraphyses and young asci. Some of the asci (Fig. e) may have young spores in them. When the perithecium has gained its full size a dark mass can be seen in the lower third. The perithecium may be ruptured by tapping lightly on the cover glass with a needle point, and a mass of asci containing either four or eight spores each, forced out. The asci escape through the wall of the perithecium and not through the mouth which is the natural avenue for the escape of the spores. This is an important point to keep in mind. This mouth (ostiolum) is easily recognized at the apex of the perithecium. By focussing carefully on this apex one can see that it is darker colored than the remainder of the perithecium, and that it is surrounded by very peculiar hairs, which decrease in size toward the base of the fruit. While watching the apex under a low power, press gently on the cover again until a small mass of colorless tissue escapes from the opening. Under a high power of the microscope it will be observed that this mass is composed of very short, colorless threads (paraphyses) which are very much like those shown in Fig. e along with the ascus, excepting that they are smaller. The whole inner surface of the perithecium is covered with these paraphyses. They are very long at the bottom, where they occur sparsely mixed with the asci. Higher up they occur in large numbers, gradually decreasing upwards in length and diameter, and above the asci in the upper two-thirds of the perithecium are very abundant. The canal leading from the asci to the ostiolum is loosely filled with these colorless filaments attached to the wall of the perithecium at one end, while the other projects upward and inward into the canal. This is a second important point to bear in mind.

A simple experiment may now be performed. With a hand lens find a large, vigorous perithecium and prod it with a needle. If the proper stage of maturity has been reached it will burst with great force and a mass of asci and paraphyses can be seen to escape. The perithecium was very turgid at this stage, due to the presence of water in the tissues. This is a third very important point.

One of the largest perithecia may be placed on the slide in a drop of water and a cover glass laid on it gently. Are all of the asci of the same height? If they are, examine again in a day or two, when some of them will stand much higher than others (Fig. c). By focusing carefully the outline of the asci which stick up above the others can be readily seen. But now, instead of being cylindrical, they are club-shaped and much wider than they were originally. In short, they are expanding tremendously. They are still attached to the base of the perithecium. By setting a micrometer eyepiece so that the apex of the ascus touches a definite mark, one can measure the rate at which the top of the ascus is moving toward the ostiolum. One ascus will always be found in advance of the others. This is the one that should be watched. It will not usually take very long for the ascus to stretch until the top of it has reached the very apex of the perithecium (three times its original length and several times its original width). It will be observed that the spores follow the apex of the ascus, and as the latter pushes its way out of the ostiolum the upper spore can be seen just emerging. Suddenly the ascus is ruptured and throws the spores out with force enough to drive them 2 mm or more through the water, and of course they would travel much further through the air. The eight spores can be seen untwisting their appendages in the water. Dr. Woronin, a German botanist, tells us that he has seen the spores thrown a distance of 15 cm through the air.

It will be well to watch other asci and see how long before each in turn ejects its spores. Interesting observations may also be made on the effect of temperature on the rate of ejection.

It is not necessary to watch the preparation all of the time in order to determine how often the asci erupt, for if the perithecium is carefully mounted and care is taken to transfer no loose spores or debris along with it, the groups of spores opposite the ostiolum can be counted at intervals. Of course the preparation must be kept from becoming dry.

The spores are provided with slender appendages which serve to hold them together in the top of the ascus while it is stretching out toward the ostiolum. One can usually detect one or more thimble-shaped bodies near the mouth of the perithecium, which are the apices of the asci broken away in the process of rupturing.

An examination of old perithecia will reveal the loss of the turgid condition, and the pressure of a needle causes no explosion.

To summarize: When the immature perithecium is ruptured by force the asci and spores escape in an irregular manner; but as it matures the ostiolum is formed, the paraphyses are arranged so as to guide the asci to the ostiolum, and to regulate their expansion, and the asci themselves expand and stretch out toward the opening, carrying in their apices the group of spores held together by slender twisted appendages. The asci reach the ostiolum one at a time and successively discharge their spores into the air with sufficient force to send them considerable distances.

Columbia University.

EXPLANATION TO PLATE.—*a*. Perithecium of Podospora curvula. x35. *b*. Another form of the same species. The horn-like processes are groups of hairs. *c*. Perithecium of Podospora minuta, showing the stretching asci. Many details are omitted for the purpose of showing the asci more clearly. x50. *d*. Apex of "b" in young stage. Notice that the hairs are connivent and that the outer bunches are just beginning to curve downward. x230. *e*. Ascus and sterile filament. x230. *f*. Spores. Observe the peculiar appendages. At the base of the spore is seen the primary appendage and attached to it are two secondary ones. Only the one attached to the lower end can usually be seen. The other illustration represents an end view showing the germ pore at the upper end of the spore. x320. *g*. Single hairs from "b." x320.

Some Notes upon the Flora of Yellowstone National Park.

AVEN NELSON.

To one who has spent several weeks collecting in Yellowstone Park, the amount that might be said of its flora seems nearly limitless. In a short article like this the chances are that one will choose the least interesting of the observations that come to mind. Nevertheless, one must choose.

One of the perennial sources of wonder is the resistance of mountain plants to frost. Nowhere may this be seen to better advantage than in the park.* Even at its average altitudes heavy freezes occur almost nightly. Delicate-appearing plants, each morning procumbent under a heavy load of frost, are after a few moments of sunshine as jauntily erect, in all their brilliancy of color, as if they had never felt any but the balmiest breezes.

If this is the condition at average altitudes, how much more wonderful are the facts in regard to alpine heights! Here no night passes that is not suggestive of an arctic clime. Temperatures reaching nearly the zero point (F.) must be of frequent occurrence. In spite of these conditions, a day's climb into one of these almost unknown workshops of mother Nature never fails to reveal, among many others, Polemoniums of soft caerulean hues, frail Saxifrages filling the clefts of lichen-covered rocks, Ranunculi of richest gold, Potentillas waving on slender wands their ladened cups, Lupines displaying their varied hues against the white banks of lingering snows, Castillejas rearing everywhere their gaudy spikes, and white and azure Columbines trying to hide by veriest profusion the broken cliffs.

But this lasts but a comparatively few days. As if their vitality had all been thrown into the few midsummer weeks, and with no courage to meet an extra emergency, they succumb to the first September storm that spreads a mantle of white over them. How hard the conditions, but how perfect are the adaptations to meet them!

The last season was one of unusal snow and many an ordinarily naked slope lay buried till August under impenetrable beds. Spring's heralds, bound by winter's bands, were delayed, but were not suppressed. On Dunraven Peak, August 27, the flowers of May were cheerily spreading their petals after their long sleep—Spring beauties, Serviceberries, Strawberries, Buttercups, and Forget-me-nots in sweet profusion.

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*A specific instance—Camp on Obsidian Creek, July 22 and 23, altitude a little more than 7,000 feet. A thick crust of ice formed in a coffee pot sitting on a camp stove in which fire had been kept till 10 o'clock at night, the stove being in a good, well-closed tent.

What is a park? To one who has long lived in the West and has come to think of a park as an open, grassy place in the forest, or who has formed his conception of a park from those beautiful, treeless plains of Colorado—North, Middle, and South Park—hemmed in by majestic mountain ranges, Yellowstone Park does not quite meet one's expectations, as a park. (As a "wonderland" no words can do it justice.) A very large portion of its area is heavily wooded. Its roads wind for miles through "the silent sea of pines." Dense and straight and tall, their swaying summits mark the passing breeze. Monotonous as are these woods of Lodge-pole Pine (*P. murrayana*) so of correspondingly striking interest among the Coniferae are the Alpine Fir (*Abies subalpina*) and Whitebark Pine (*P. albicaulis*) which the writer here saw for the first time.

Parasitism is abundantly illustrated in all floras, but nowhere, perhaps, so profusely by a single parasite. The Small American Mistletoe (*Razoumofskya americana*) is met with everywhere, within the bounds of the park, upon the Lodge-pole Pine. In some places nearly every tree for miles around is infected, and it is too apparent that most serious inroads are made upon the health and vitality of the host—the very existence of this part of the forest cover being threatened.

Two floras meet in the park. Mountain summits and high valleys are occupied by a flora which has its center of distribution in much higher altitudes. On the formations about the hot springs and geysers, on the banks of the warm streams, and in many places where internal heat keeps the surface at a relatively high temperature there occur species which are either identical with or similar to those of lower latitudes or altitudes. Many species that have been reported from the park are far out of their supposed range.

Though the season for some of the species is exceedingly short, yet for others, as some Mimuli and Epilobiums, which love the marshy banks of warm streams, it is correspondingly long. Heat-loving plants abound everywhere, but perhaps there are none that interest the visitor more than the thermal Algae. Dr. Setchell's announced work will be a welcome addition to our meager knowledge of these plants that have, in some instances, adapted themselves to almost boiling water.

Of the Moss flora nothing is known except from very recent collectors. Nothing can be more curious than the way in which several species have adapted themselves to the hot areas about the springs and 'paint pots.' These species seem to form a turf, sometimes of great extent, which rests upon a substratum of air rather than upon the hot, underlying crust. This provision for a circulation of air under the moss bed is an adaptation to environment so evident that it may not be misunderstood.

Like the other Cryptogams the Fungi of the park are almost wholly unknown. A fair series of the parasitic forms are now in hand, but of the fleshly ones probably nothing is known. Magnificent specimens of Agarics and Boleti abound, offering to the mycophagist, as well as to the systematist, an extensive field for research.

Lichens abound on stock and stone, embellishing everything with their varied hues. Golden Gate receives its name from the lichen decorations on the cliffs through which the road winds at that point. No visitor to the park can fail to note the superabundance of the yellow tufts of *Evernia vulpina* which occurs everywhere on the dead logs and branches along the miles of forest roads.

If allowed to single out but one for special mention from among the flowering plants, that singularly beautiful Buttercup, *Ranunculus eximius* Greene, comes first to mind. Now for the first time secured in abundance, as seen in its alpine valley, it will ever be remembered as one plant that is worthy of its name.

The Geographical Distribution of the Teretifolium Group of Talinum.

JOHN M. HOLZINGER.

It was my purpose primarily to ascertain, if possible, the geographical range of *Talinum rugospermum.* To this end I asked permission to see the *Talinum* material in the following herbaria: The University of Minnesota, the South Dakota Agricultural College, the universities of Wisconsin, Chicago, and Illinois, and the Missouri Botanical Garden. Through the courtesy of Professors Conway MacMillan, D. A. Saunders, R. A. Harper, Charles R. Barnes, G. P. Clinton, and Dr. Wm. Trelease, respectively, I have been able to see these collections. From Dr. J. N. Rose, of the National Herbarium, I have received valuable aid toward understanding the type of *Talinum teretifolium*, and Mr. L. R. Moyer, of Montevideo, Minn., has sent me from his herbarium the plant that occurs in his vicinity. To all these gentlemen I desire here to express my appreciation and cordial thanks for their assistance.

Of the material submitted to me from these sources the collection from the herbarium of the Missouri Botanical Garden was especially rich, comprising in all not less than 104 sheets. It seems convenient for brevity's sake to recognize two general groups of Talinum: the *patens* group, represented in Arizona, New Mexico, and Florida by several broad-leafed species, notably *Talinum patens*; and the *teretifolium* group, headed by *Talinum teretifolium.* To this latter group we should probably add *Talinum pygmaeum* Gray, ranging from Colorado (C. C. Parry, 1872; Dr. Vasey, No. 14864, no date, from Berthout Pass) to Southern California (Coville, No. 1799, Death Valley Expedition, 1891); *Talinum humile* Greene, found in New Mexico (Edw. L. Greene, Pinos Altos Mountains, August 11, 1880); and *Talinum spinescens* Torr, found in Washington State (T. S. Brandegee, Yakima region, June, 1882; Dr. J. H. Sandberg, Wilson Creek, June, 1893). It is, however, with those species which remain, and whose range is principally east of the Rocky Mountains, that we are here concerned.

Naturally enough, my first thought in examining the collections submitted was to determine whether *Talinum rugospermum* was present. In addition to plants from the type locality, Trempealeau Prairie, Wis., and St. Croix Falls, Wis., given in the *Bulletin* for December, 1899, the collection in the herbarium of the University of Minnesota contains a plant collected near Zumbrota, Goodhue County, by Mr. A. P. Anderson in August, 1894, establishing so far the first station in Minnesota for the new species. It is probable, however, judging by the physiographic features of the territory between St. Croix Falls and Lake Superior, that the plant from near Duluth, recorded in Upham's Catalogue of the Flora of Minnesota, on the authority of Miss Cathcart, may also belong here. The stations established in Wisconsin are: "Marquette County," by a plant without other data; Dane County, by a plant collected in 1858 by I. A. Lapham; the Valley of the Wisconsin River, by a plant collected in 1894 by L. S. Cheney (No. 3753); and Black River Falls, by a plant collected in "July, 1869," without other data. For Illinois I have found the following stations: Oquawka, H. N. Patterson, without date; Oregon, Ogle County, A. B. S. [eymour], September 25, 1882; and Dixon, Lee County, without other data. In Indiana the plant is so far known only in the northwest corner, in Lake County, from a specimen collected by H. A. Warne, No. 30521, without other data. All this range—Northwest Indiana, Illinois, Wisconsin, East Minnesota—as is evident from the material examined, is lost from that accredited to *Talinum teretifolium*, and belongs to *Talinum rugospermum*.

In Britton and Brown's Flora *Talinum teretifolium* is assigned a range from Chester County, Pa., to Minnesota and Texas. I have not seen all the material extant on which this assignment of range is based, but from a glimpse at the plants in the herbarium of the Missouri Botanical Garden, referred to this species, I desire to record a cautious doubt regarding the following: J. W. Blankenship's plants from Greene County, Mo.; Engelman's, No. 214, collected in May, 1855, between the Osage Fork of Gasconade River and the James Fork of White River, Mo.; C. Russell's plants, one from Pilot Knob, Mo., June 25, 1895, the other from Buzzard Mountain, Mo., July, 1897; and A. S. Hitchcock's plant, collected near Lincoln, Neb., in 1895. Until these plants from Nebraska and Missouri—and the Texas plants as well, which I have not seen—are collected again, and studied in the field, and are proved to have the *flower* characters, and the *time* of bloom as established by Dr. Harshberger for true *Talinum teretifolium*, this species can not with certainty claim any territory west of the Mississippi. And the only part of the range left undisputed for this species extends from Pennsylvania through North Carolina to Alabama.

Concerning the range of *Talinum calycinum* Engelm., authentic specimens in the herbarium of the Missouri Botanical Garden show that it is found in Kansas, Indian Territory, and Texas.

The case is different when we come to *Talinum parviflorum* Nutt. The range assigned to this species in Britton and Brown's Flora is from "Minnesota to Arkansas, New Mexico and Texas." The plants over this territory generally referred to this species seem to me to represent at least two, and probably three, distinct species. The fact that Dr. Gray has discredited *Talinum confertiflorum* Greene, as a distinct species only adds to the confusion. This plant is represented in the herbarium of the Missouri Botanical Garden by two sheets: one with a plant collected on the Pinos Altos Mountains, September 13, 1880, by Dr. E. L. Greene himself; the other, with a plant from the Mogollan Mountains in September,, 1881, by H. H. Rusby. With the present light on this group of *Talinum* there is reason to accept this as a valid species; further field study will probably establish its right to stand. But even if we leave this plant out of the question, there are still two forms referred to *Talinum parviflorum* Nutt. The one of these, at once recognized by its distinctly elongated capsules, as figured in Britton and Brown's Flora for this species, ranges through Minnesota, South Dakota, and Iowa, so far as specimens examined go to show. The other, recognized by its rather shorter capsule, and especially by its *very small, persistent sepals* (in *Talinum calycinum* they are large), has a range extending from Nebraska through Colorado, Indian Territory, Arizona, and New Mexico. The type locality for *T. parviflorum* Nutt. is given, "on rocks, *Arkansas*," in Torrey and Gray's Flora of North America, I, 197. While I have not seen a plant from that State, it is reasonable to assume that, if *either* the Northern or Southern plant, of the two above pointed out, is Nuttall's species, it must be the latter. And the Minnesota, Dakota, Iowa plant, if it proves on closer study to be actually distinct, will have to be disposed of otherwise.

Further, there is some reason to think that Neally's plants from Texas, referred to this species, will be found distinct from it and also from *Talinum confertiflorum.* But this, as well as the other points raised in this paper, can be satisfactorily settled only by patient study and observation of the plants in the field. The *time* of *flower opening* becomes an important point to be observed and noted. Then, individual flowers need to be pressed separately between tissue paper while expanded; if left to dry on the plant while pressing, they are almost sure to curl up. An adequate amount of ripe seed should also be secured for each specimen. Material thus represented I desire very much to see collected during the coming season at all stations in the States west of the Mississippi River.

State Normal School, Winona, Minn.

Shorter Articles.

Railways Preserve the Native Flora.

Much has been written concerning the railway as an agent in carrying weeds from one section of country to another. This agency has been very marked in the distribution of the Russian thistle, but I wish to call attention to the railway as a preserving agency, for without it many plants of the prairie flora would now be extinct in Illinois.

Returning to my old home after a twelve years' absence, I expected to see again those delicate and beautiful wild flowers which I had missed in the cold, dry climate of the Northwest.

But what a disappointment! The prairies had disappeared, the sloughs had been drained and cultivated, and along the roadside grew only such tenacious plants as Helianthus, Solidago, and Silphium, with the coarser annuals.

A visit to the woods was hardly more satisfactory. The large trees were gone and the land pastured till I found only a few trampled Podophyllums and Trilliums among the stumps and undergrowth. I started home in disgust.

On the way I had to cross the railroad, and as it was a little nearer, followed it for some distance. Suddenly I saw a plant just inside the railroad fence that made me catch my breath. I hurried down the embankment and knelt before it with a thrill of that old flower worship with which, when a child, I used to greet the first spring blossom.

This flower was a white Dodecatheon, and rarely have I seen a more beautiful specimen. Rising from a mat of large leaves, the smooth scape was crowned with a cluster of buds and nineteen great white blossoms. After a rapid search I found several other plants, which I carried away for the home garden, but left this white beauty undisturbed.

Farther on I found Claytonias and the beautiful spotted leaves of the Erythronium, and, after following the railroad about half a mile, it crossed a little hillock where on either side were strips of prairie. These had, in a measure, escaped the all-devastating blue grass, and here were great patches of Pedicularis canadensis, Dodecatheon media, Viola pedatifida, Viola palmata, the rare and beautiful Viola pedata, and the wild Hyacinth, Camassia Fraseri. There were other plants not in flower which I remembered to be Phlox, Gentiana, Liatris, Coreopsis, and Tradescantia.

In the course of my summer excursions I found some small areas of unpastured woodland which yielded treasures at every visit, but they never equaled in interest my old friends growing inside the railroad fences, for many of these latter I found nowhere else.

All summer long they came in quick succession, and from the Claytonias and Erythroniums of early spring, to the Asters and Gentians of late autumn, they brought me all the old-time pleasure.

Ernest N. Wilcox.

Thawville, Ill.

The White Blackberry.

In Rhodora (Vol. 1, No. 11) A. M. Mitchell describes this seeming freak, citing Professor Bailey as authority for recognizing it as a variety of Rubus nigrobaccus. She states that while veteran berry-pickers are familiar with it at Hinsdale, N. H., she found no one who had ever seen more than a single bush, or who regarded it otherwise than as a curiosity.

When a child I remember hearing my father relate having found an occasional bush of "white blackberries," growing among those of normal fruit on his father's farm. I inferred that these albinos were rare. A few years ago an uncle living on the old homestead transplanted several of the bushes (which are readily distinguished from their companions by the lighter color of the stems) to the orchard. They have increased in number, and have borne fruit for some years. Two years ago he shared with us; but, owing to unfavorable conditions, only three or four established themselves permanently in the new home. Of these, one fruited last season for the first time. The berries were small and somewhat amber-tinted. Comparing this fruit with that taken from the parent bushes as the season was about over, I infer that the latter, being in their prime, produced berries of larger size, but little inferior to the common black fruit; while the flavor is described by all who have tasted them as very sweet and pleasant.

That the bushes have retained their peculiarity through two transplantings emphasizes the wisdom of regarding the form a variety rather than a "freak"

Bessie L. Putnam.

Willow Notes.

May 13, 1899, I found a Salix nigra in bloom, whose aments are perfect, pistillate and staminate flowers in the same ament, and the stamens (mostly 5) standing on the disk and surrounding the capsule. The upper halves of the aments are entirely pistillate.

According to the doctrine of evolution the most developed plants must be the youngest in the course of ages. As the willow family is a proportionally little developed one with otherwise strictly dioecious species, the specimen in question would seem to be a long step through the monoecious to the perfect form, indicating that old plant forms, that we think of having reached their culmination, may in the course of centuries develop into higher forms, so that the willow, for instance, may be one time a monoecious plant and bear at the next step always perfect flowers.

Or should this perfect willow flower be a relapse from a higher to a lower degree, as we often notice the same in breedings of our domestic animals and cultivated plants? Then of course the perfect and monoecious forms would be the older ones, and we have to turn topsy-turvy the edifice of our speculations.

A. Wetzstein.

St. Mary's, Ohio.

Among the Mycologists.

The first Fleshy Fungus reported to the Washington Mycological Club this season was *Gyromitra esculenta*, a specimen of which was found at Takoma Park, D. C., on March 23. The morels may be expected soon. Last year they were found in abundance at Garrett Park, Md., and they are usually more or less common in the immediate vicinity of the Potomac River and in Rock Creek Park.

Subjects that have been discussed at recent meetings of the Washington Mycological Club are "The Woody Fungi of the Dismal Swamp," by Paul Bartsch; "Alaskan Lichens," by T. A. Williams; and "Notes on the Species of Calostoma," by C. L. Shear.

E. M. W.

The *Strand Magazine* for March contains an interesting article on "Pictures on Fungi," which is illustrated from photographs of etchings on large "Polypores," the work of Mrs. Martha P. Cooper, of Concord, N. H.

In the Eleventh Annual Report (1900) of the Missouri Botanical Garden Mr. H. von Schrenk publishes an interesting article on certain diseases of the Bald cypress (*Taxodium distichum*) and the Incense cedar (*Libocedrus decurrens*). The first is known as "Peckiness," and the author thinks it due to a fungus, but he has as yet been unable to secure mature specimens of it and hence is uncertain as to its exact botanical position. The second, known as the "pin" disease of the Incense cedar agrees with the first in most respects and is regarded as probably caused by the same fungus.

Recent Literature.

Contributions from the Gray Herbarium of Harvard University, New Series, No. XVIII, issued March 16, contains the following articles: New Species and Varieties of Mexican Plants, by J. M. Greenman; Synopses of the Genera Jaegeria and Russelia, and New Rhaenogams, chiefly Gamopetalae, from Mexico and Central America, by B. L. Robinson; and New Dioscoreas from Mexico, by E. B. Uline.

Among recent Experiment Station Bulletins of special intrest to botanists are "The Elms and Their Diseases" (Bull. No. 84), by Prof. H. Garman, of the Kentucky Experiment Station; "Some Native Forage Plants for Alkali Soils" (Bull. No. 42), by Prof. Aven Nelson, of the Wyoming Experiment Station; and "The Trees of Vermont" (Bull. No. 73), by Anna M. Clark, prepared under the direction of Prof. L. R. Jones, of the Vermont Experiment Station. The last is a particularly noteworthy publication and contains popular descriptions of all the native and introduced species with notes as to their distribution and economic value. It is illustrated by numerous cuts from drawings by the author.

One of the latest books designed for "Beginners who have not at hand the facilities of a laboratory" is Dr. MacDougal's "The Nature and Work of Plants."* As the author says in his preface, the work is essentially "a study of the functions or action of the plant, and organs are considered chiefly as instruments for the performing of work, with but little attention to their morphology." It is a clear, concise statement of fundamental principles and facts, with suggestions as to how these may be substantiated by the student, and is written in the attractive style which characterizes all of Dr. MacDougal's writings. It is at once popular and scientific. A short bibliography of manuals and reference books is given with suggestions as to how the necessary materials for study may be secured. The work is divided into ten chapters as follows: The Composition and Purposes of Plants; The Material of Which Plants Are Made Up; The Manner in Which Different Kinds of Work Are Divided Among the Members of the Body; The Roots; The Leaves; Stems; The Way in Which New Plants Arise; Seeds and Fruits; The Power or Energy of the Plant; Relations of Plants to Each Other; and the Place in Which They Live. This is one of the first popular elementary treatises published in this country, written from the standpoint of the plant physiologist, and will do much to popularize this phase of botanical study.

In the Journal of the Cincinnati Society of Natural History for 1899, Prof. A. P. Morgan published his fifth paper on "The Myxomycetes of the Miami Valley." This contribution is devoted entirely to the subject of classification. The author gives a review of the systematic literature dealing with the Myxomycetes from the time of the earliest writers, such as Ray and Bonanni, to Massee's recent monograph. Outlines of classifications established by the leading students of the group are given, and the author closes his paper with a synopsis of the orders and genera of North American Myxomycetes according to his own ideas as to their classification. He divides the North American species into four sections, nine orders, and thirty-nine genera. The four sections are: Peritricheae, Calonemata, Columelliferae, and Calcareae. The first containing the orders Liceaceae, Reticulariaceae, and Lycogalaceae; the second the Perichaenaceae, Arcyriaceae, and Trichiaceae; the third the Stemonitaceae; and the fourth the Didymiaceae and Physaraceae.

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*THE NATURE AND WORK OF PLANTS, an introduction to the study of botany by Daniel Trembly MacDougal, Ph. D., director of the laboratories, New York Botanical Garden. The MacMillan Co., N. Y., 80c net.

T. A. W.

The first edition of Pfeffer's Physiology of Plants was published in 1881, and though never translated, has had a decided influence upon the development of plant physiology in England and America. The many years that have passed since the first edition was published have witnessed numerous changes in the old conceptions of the meaning of many physiological phenomena and the discovery of important new facts. The revised German edition, which appeared in 1897, is, as Dr. Pfeffer says in the preface, essentially a new work, bringing the general principles of vegetable physiology into accord with the more recent well-ascertained facts. The scope of the work has not been enlarged, dealing only, as is stated in the preface, with the fundamental principles of metabolism and the sources of energy. As in the first edition, a knowledge of general botany (anatomy, morphology and physiology), as well as physics and chemistry, is assumed on the part of the reader. The translation of this last edition makes it much more accessible to English and American students, as the original German is generally admitted to be quite difficult reading.*

Mr. Ewart, as well as the English-reading botanical public, is to be congratulated upon the very excellent rendering of the original meaning. The English edition also contains numerous references to recent literature not found in the original. A good index is also added.

As to the general make-up of the book, the Clarendon Press has not departed from its high standard. The paper, binding and print correspond with Goebel's Outlines of Morphology, the translations of De Bary's works, and Sach's Physiology. Even to those who have the original German, the translation will be a very welcome addition.

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*THE PHYSIOLOGY OF PLANTS. A Treatise Upon the Metabolism and Sources of Energy in Plants, by Dr. W. Pfeffer, second fully revised edition translated and edited by Alfred J. Ewart, Vol. 1, Oxford, Clarendon Press, 1900.

Albert F. Woods.

United States Department
of Agriculture.

News and Notes.

It is to be regetted that Prof. Wm. C. Barbour found it necessary to tender his resignation as secretary of Division B, Gray Memorial Botanical Chapter. Mr. S. H. Burnham was appointed to fill the vacancy, and has kindly accepted the position. Mr. Burnham has been long and favorably known as a proficient member of the chapter—remaining with it through prosperity and adversity, and now shows his continued interest by accepting this, by no means, desirable position.

J. A. G.

During the coming session, lasting from July 5 to August 16, the Botanical Staff of the Department of Botany of the Marine Biological Laboratory at Woods Holl, Mass., will offer three laboratory and lecture courses, namely: (1) Cryptogamic Botany, (2) Plant Physiology, (3) Plant Cytology and Microtechnique. The instruction will be in charge of Dr. Bradley Moore Davis, of Chicago University; Dr. Geo. T. Moore, of Dartmouth College; and Dr. Rodney H. True, of Harvard. In addition to the regular work an attractive programme of general lectures has been arranged covering a wide range of subjects and in which Dr. D. T. MacDougal, Dr. Douglas H. Campbell, Dr. Erwin F. Smith, Dr. Geo. F. Atkinson, Dr. J. M. Macfarlane, and other prominent specialists will take part. Applications for admission should be made to Dr. Davis at the University of Chicago, Chicago, Ill.

Separates have recently been distributed of the address of the president, Dr. W. G. Farlow, before the American Society of Naturalists, delivered at New Haven. Conn., December 28,

1899. In his address Dr. Farlow makes some interesting comparisons of the various methods of organization of universities and other scientific institutions in this country and in Europe. He dwells particularly on the differences in organization between the German universities and those of our own country, and argues against the concentration of scientific work in any one center, as for example, in a national university, holding that "Our country is so large and so varied in population and occupation that we need many independent centers of learning and numerous universities zealous in promoting knowledge." Dr. Farlow has a wide personal knowledge of the scientific institutions of the Old World, as well as of those of this country, and his address will be read with interest and profit by all who are interested in the advancement of scientific learning.

At the Columbus meeting of the Botanical Society of America Dr. Wm. Trelease read a paper on the classification of botanical publications which elicited a great deal of interest and discussion, and which was by request also presented to Section G of the American Association for the Advancement of Science. The paper was published in *Science* for November, 17, 1899. The scheme proposed by Dr. Trelease arranges botanical publications under nine different series, and these are further divided and subdivided according to a plan which makes the whole readily adaptable to the decimal system of classification now in common use in the libraries of this country. The scheme is certainly an admirable one, and will no doubt find immediate application in the larger botanical libraries of our universities and other scientific institutions.

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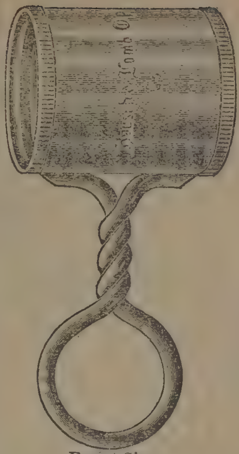

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Fig. 6. Noonday position of the leaves of the sensitive plant.

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PLANT LIFE IN FIELD, FOREST AND GARDEN.

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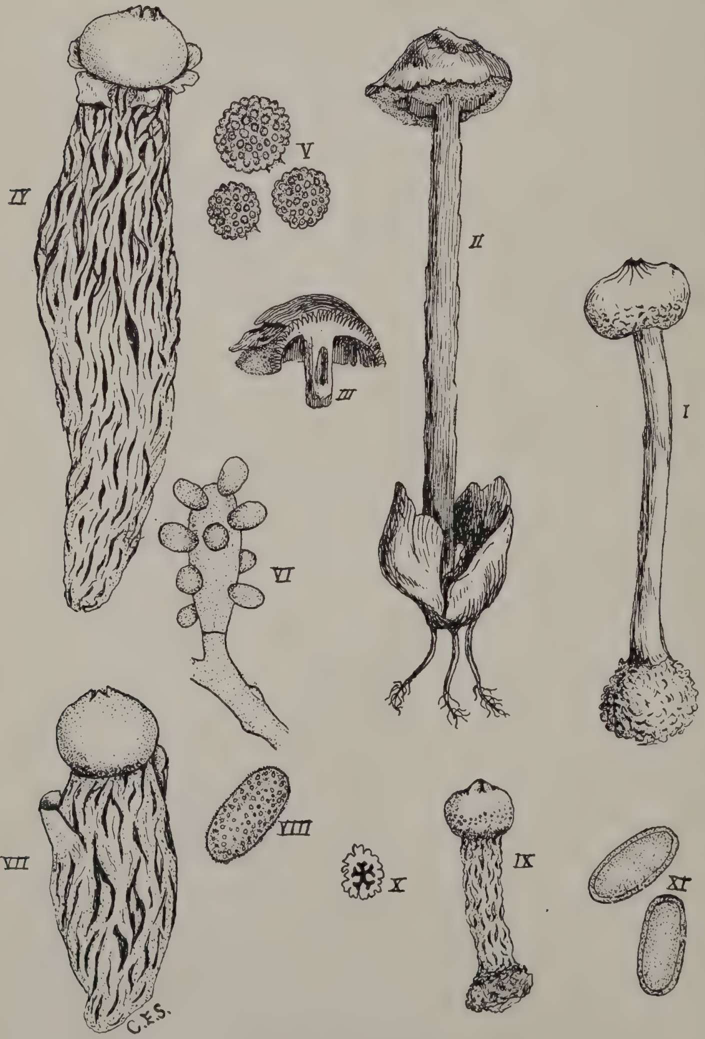

SHEAR ON PUFFBALLS.

Asa Gray Bulletin.

VOL. VIII. No. 3. JUNE, 1900. Whole No. 38.

Our Puffballs.—III.

C. L. SHEAR.

In this paper three genera of our American *Diplodermeae*, *Battarrea*, *Calostoma*, and part of *Tylostoma* will be treated; the two remaining genera, *Geaster* and *Broomeja* to be taken up in the next paper.

DIPLODERMEAE.

Peridium mostly rather thin, consisting of two or in *Calostoma* three layers, the outer soon disappearing or persistent; gleba floccose-pulverulent; capillitium not very compact, rarely none.

SYNOPSIS OF THE GENERA.

1. Plants with a distinct stipe.
    - *a*. Inner peridium more or less hemispherical, rupturing about the lower margin.....*Battarrea*
    - *b*. Inner peridium, opening at the apex by a bright-colored stellate mouth ....*Calostoma*
    - *c*. Inner peridium, globose with an entire or somewhat lacerate apical mouth, not bright-colored.......................*Tylostoma*
2. Plants without a distinct stipe.
    - *a*. Outer peridium, rupturing in a stellate manner, enclosing a single inner peridium....*Geaster*
    - *b*. Outer peridium, not rupturing in a regular stellate manner, enclosing several more or less crowded peridia..............*Broomeja*

BATTARREA Pers.

Outer peridium volva-like, rupturing irregularly, persistent; stipe hollow, surface scaly; inner peridium hemispherical, plane or depressed beneath, rupturing below the margin, the upper part falling away; capillitium of simple or branched threads with spiral or ring-like thickenings. A genus poorly known and apparently out of place here. Very few American specimens yet collected.

13. **Battarrea phalloides** (Dicks.) Pers. Pl. III. Figs. II, III. Plant ovate, at first sunk several inches beneath the soil; outer peridium fleshy, whitish, mucilaginous within, rupturing irregularly at the apex; stipe cylindric, fleshy, lacerate-strigose, 25-30 cm. high, 1-1.5 cm. thick; inner peridium hemispheric, brown, depressed underneath, rupturing about the margin, the upper portion falling away; spores brown. Sandy soil. California and Arizona.

14. **Battarrea digueti** Pat. & Har. Outer peridium chalky, more or less persistent on the surface of the inner, composed of three parts, the outer coriaceous, simple, the middle consisting of 10-20 thin membranous plates, the inner part thick and hard, remaining attached to the base of the stipe in the form of a sheath; stipe pale yellow, scaly, deeply furrowed, hollow, 15-20 cm. high, 8-10 mm. thick. Inner peridium globose-flattened, membranaceous, white, deeply depressed below, at length breaking up more or less and forming pores scattered irregularly over the surface, the lower part connected with the stipe; gleba yellowish-brown; threads of the capillitium thick-walled, 6-7 mic. thick; spores globose, brown, nearly smooth, 5-6 mic. diam., mixed with simple fusiform colorless cells 100-150x4-7 mic., marked with yellowish rings. California, Diguet.

15. **Battarrea attenuata** Pk. Outer peridium unknown; inner peridium 5 cm. in diameter, even and concave beneath, convex above, with broad shallow depressions, giving the surface a reticulate appearance; stipe 20-25 cm. high, hard, solid, brown, attenuated toward the base, with coarse spreading or reflexed scales except at the top; thread of the capillitium without thickenings; spores globose, ferruginous, 7.5 mic. diam. Dry, sandy soil. Nevada.

CALOSTOMA Desv.
Mitremyces in Sacc.

Plant enveloped in a universal volva, which usually disappears before the peridium appears above the ground; outer peridium continuous at first, soon rupturing irregularly just above the middle, the upper portion falling away entire, the lower portion breaking up and remaining attached to the inner peridium or spreading and remaining as a volva at the base; inner peridium, with an apical, toothed mouth, enclosing a thin spore-sac attached to the teeth; stipe composed of anastamosing gelatinous strands, very hard when dry.

16. **Calostoma cinnabarinum** Desv. Pl. III. Figs. VII, VIII. Outer peridium vermilion within, rupturing irregularly, some of the lower portion spreading and remaining attached at the base of the inner peridium, upper portion falling away in the form of a lid; inner peridium vermilion at first, usually somewhat faded with age; mouth vermilion, teeth 4-7; stipe brownish, 1-6 cm. high, 1-3 cm. thick; spores elliptic-oblong, echinulate or punctate, pale ochraceous, 15-18x8-10 mic. Moist soil, banks of woodland streams. Massachusetts to Ohio, south to Carolina and Texas.

17. **Calostoma lutescens** (Schw.) Burnap. Pl. III. Figs. IV, V, VI. Outer peridium, pale yellowish, rupturing about the middle part of the upper portion, remaining entire and falling away as a lid from the mouth, and bearing the bright vermilion marks of the teeth, the central portion breaking up and falling away in pieces, the basal portion irregularly torn and spread, remaining attached at the base; inner peridium depressed globose, somewhat flattened at the base, pale yellowish, 2-3 cm. diam. at the base; teeth, 6-8 with vermilion margins; stipe stout, yellowish, 5-12 cm. high, 2-3 cm. thick when fresh, shrinking much in drying, strands finer than in the preceding species; spores pale yellowish, globose, verrucose, 7-10 mic. This is distinguished from the preceding species by the absence of the vermilion color on the peridium, its larger size and different shaped spores. It has been reported from Alabama, West Virginia and

Virginia. It has been collected several times in the vicinity of Washington by myself and others. It occurs on sandy banks and margins of woodland streams usually in groups of two to half a dozen.

18. **Calostoma ravenelii** (Berk.) Mass. Pl. III. Figs. IX, X, XI. Outer peridium pale yellowish, rupturing irregularly above the middle, the upper portion falling away entire, and marked on the inner surface by the vermilion of the teeth, the lower portion breaking up into numerous scales, which remain attached to the inner peridium; inner peridium globose, pale yellowish, 1-2 cm. diam.; teeth as in the preceding; stipe stout, mostly 3-5 cm. high, strands coarse, uneven; spores elliptic-oblong, smooth, 12-16x7-8 mic.

Calostoma ravenelii minor (Berk.) is a very small form of this species.

This species does not seem to have been reported heretofore from anywhere but North and South Carolina. It has been found by myself and others in considerable numbers in the vicinity of Washington, and is apparently our commonest species. It grows in somewhat clayey soil in pine woods, and is distinguished from *C. lutescens* by its smaller size, globose peridium, and the lower part of the outer peridium remaining attached to the inner in small scales, also in the spores, as will be seen by comparing descriptions. This species will be distributed in Century XV. of Fungi Columbiani Continued.

TYLOSTOMA Pers.

Outer peridium a soft, fragile layer, breaking up into scales, and falling away sooner or later; inner peridium depressed globose, the basal portion, which is thickened at first, becoming prolonged into a distinct stipe at maturity, membranaceous or somewhat coriaceous, opening by a more or less regular mouth; capillitium arising from the inner surface of the peridium; threads long, hyaline, branched.

19. **Tylostoma mammosum** (Mich.) Fr. Outer peridium of minute brown scales soon falling away; inner peridium 6-12 mm. diam., membranaceous, smooth, whitish; mouth small

with entire margin; stipe slender, 3-5 cm. high, 5-6 mm. thick, scaly, becoming smooth, at first stuffed with long, loose threads, finally hollow; threads of capillitium, 4-5 mic. diam.; spores globose, brown, with a minutely warty surface, 4.5-5.5 mic. diam. Rich sandy soil, New York to North Carolina, west to Colorado and New Mexico.

20. **Tylostoma obesum** C. & E. Inner peridium with a short entire collar at the base and a round, obtuse, entire (?) mouth; stipe about 2 cm. high, stout, naked, somewhat thickened downward; capillitium smooth brown; spores rusty brown, globose, nearly smooth, about 6 mic. diam. Colorado.

Prof. Morgan regards this as a mere form of *T. meyenianum* Klotsch.

21. **Tylostoma fimbriatum** Fr. Pl. III. Fig. I. Outer peridium of minute scales, soon disappearing; inner peridium membranaceous, smooth, brown, 10-12 mm. diam.; the mouth ciliate-fimbriate; stipe 3-4 cm. high, about 5 mm. thick, brown and scaly without, white and stuffed within, with a thickened mass of mycelium at the base; threads of the capillitium long, hyaline, branched, 5-6 mic. thick; spores sub-globose, pale brown, minutely warted, 5-6 mic. diam. Sandy soil, New York to North Carolina, west to Kansas and New Mexico.

EXPLANATION OF PLATE.

Fig. I. *Tylostoma fimbriatum* (after Morgan). Figs. II, III. *Battarrea phalloides*; II, the entire plant; III, a vertical section of the peridium and upper portion of the stipe (after Persoon). Figs. IV, V, VI, *Calostoma lutescens*; IV, the mature plant; V, spores highly magnified; VI, basidium with spores attached (after Burnap). Figs. VII, VIII. *Calostoma cinnadarinum*; VII, a mature plant; VIII, spore highly magnified (after Massee). Figs. IX, X, XI. *Calostoma ravenelii*; IX, a mature plant; X, a ventral view of the upper portion of the outer peridium, showing the marks left by the teeth of the inner peridium; XI, spores highly magnified (from nature).

Gardening by the Columbia, Missouri, Public Schools.

PROF. J. C. WHITTEN.

At the present time interest in introducing various forms of "nature studies" into the schools is becoming so widespread that successful methods of doing the work are of unusual interest to teachers. While a great many teachers agree that so-called nature studies have a value, a large number are at a loss to know how best to introduce the work. Some who theoretically would like to see the work done contend that there is no time for studies other than those heretofore taught; that the schedule is already full, and wonder what may be dropped from the present list of subjects in order to make room for another. There are numerous examples, however, of schools that have very successfully begun the work, in one way or another; in some cases it is made to supplement a part of the work in geography, by taking the geography lesson to the field; in others, a part of the language work is made to deal with plants and living things, and still in other cases it has been taken up independently, as required work, or as a kind of recreation outside the regular school hours.

Work done by the Columbia, Missouri, public schools, during the present year, is one of the best examples that has come to the writer's notice of how successful plant studies may be introduced. The work was mainly planned by Mr. Peter Potter, the teacher of natural science in the high school, and shows how successfully an industrious teacher may inculcate into the minds of his students a love of plant study and plant culture.

The first step was window gardening in the biological laboratory of the high school. A plant box 8 inches wide, 6 inches high, and the length of the window sill, was placed at either window in the room. These boxes were filled with mellow garden soil and woods mould, and planted. Ferns were set in the boxes of the north windows, where they would not get too much sunlight. In the east and west windows geraniums, coleus umbrella plant and other attractive forms that need more sunlight were set. From some of the boxes parlor ivy and other vines were trained about the sides of the windows. Aside from being an attractive object lesson to the whole school, these boxes furnished material for study to the class in botany. The germination of seeds, the development of young plants, the rooting of cuttings and other work was carried on in the soil, under the ornamental plants, while these plants themselves gave opportunity for experiments in plant growth. The influence of light on plants was observed in those that liked sunshine and turned toward it, as well as those that preferred shade and grew away from the light. The development of green coloring matter in the leaves was observed by covering leaves for a time to shut out the light until they lost their color, and then watching its gradual development when the covers were removed. The ingenuity of the teacher was displayed in numerous experiments with these living plants, and this served to stimulate an interest in the work on the part of the pupils.

In February arrangement was made for studying the development of wild plants. A bench 20 feet long, 3 feet wide and 8 inches deep was made of bits of boards from packing boxes and waste lumber from the basement of the building. This bench was supported by means of four carpenters' trusses, along the west side of the laboratory, where it would get light from four windows. A trip was then made to the woods with a spring wagon, furnished by one of the students, for the purpose of securing plants for this bench. Quantities of the woods mould, containing forest tree seeds, ferns, and the various bulbs, rootstalks and other curious things that grow in such places, were shoveled in and taken to the school building and placed in the propagating bench. Great interest was manifested on the part of the students in finding out what kind of plant would develop from a given curious rhizome or what insect might emerge from a strange cocoon that was found in the soil at the time of planting out the miscellaneous collection. In a few weeks this curiosity began to find ample opportunity to satisfy itself. Under the influence of the warmth and sunlight from the windows a luxuriant growth soon began. Oak, hickory and other seedlings began to appear; spring beauties and anemonellas sprung from some of the onion-like bulbs; some curious dormant plants massed in one corner developed into a fine bed of the native columbine, and later put out their bright red and golden flowers. Throughout late winter and early spring, every day brought its succession of surprises in the shape of the first violet flower, unfolding fern or other well-known acquaintance of every lover of the first plants of springtime. It was a revelation to the students, and to most older people as well, to see a few dead-looking seeds and unknown bulbs and roots develop into the familiar plants which they had always loved, and which they thought they had known so well. Even the insects, coming from their winter sleep among the leaves, added to the cheeriness of the springtime welcome. It is needless to add that other students than the class in botany became interested in this house-garden, and spent many a spare hour observing it out of school time. It was even noticeable that some of the teachers who had heretofore eaten their lunch in the principal's office, now came to the biological laboratory to spend their intermission hours. The presence of the flowering plants suggested the need of pictures on the wall, of neater blackboards and of clean window panes. Who can tell what additional inspiration and love of teaching may have been engendered by the presence of this student's garden, and the enthusiasm it created. And yet, some biological laboratories contain nothing more attractive or inspiring than a collection of half-cleaned skins and skeletons of small animals and the remnants of dissected grasshoppers.

Trips to the woods to collect material for this garden suggested the desirability of home plantings on the part of some of the students. A section of this plant bench was filled with sand, which was carefully watered, and this served as a propagating bed. The pupils brought slips of geranium, coleus and other house plants, which were inserted in the sand until they rooted, and then were taken home and planted about the house.

As warm weather approached, out-of-door gardening was begun. The ground about the school building was first graded where grading was necessary. When a trip to the woods was proposed after school or on a holiday, to collect wild vines and shrubs, the teacher had abundant enthusiastic followers, and horses and wagons were not at all difficult to secure. The native Virginia creeper was taken up and planted against the walls of the building, and trained over the doorways and in the blank spaces between the windows. Elder, red bud, spiraeas, June berry, dogwood and other wild shrubs were planted in masses about the steps, in the angles of the building, as screens for the outbuildings, and wherever they would enhance the beauty of the grounds. The soil was spaded fine around each mass of shrubbery, under whose shade wild-wood flowers were thickly planted.

This work done, the enthusiasm for gardening was sufficiently great that it was thought best to induce the pupils to undertake independent work of this kind at their homes. Funds were raised and prizes offered to the various grades for the best vegetable garden, the best kept yard and the best nasturtium planting, made and cared for during the season by the pupil himself. Judges were appointed to examine these gardens, pass upon their merits and award the prizes. Several hundred students entered this gardening contest, and the merits of the work as an instructive occupation for the pupils and as a means of beautifying the town is already apparent. Circulars were written, giving brief, simple directions for the various kinds of work. Copies of these were printed by the students themselves, at the high school, and distributed for the information of the contestants.

Separate prizes were offered for the colored schools, and here the work found its most enthusiastic followers. In no other part of the town has so much improvement been noted. Fences have been straightened and repaired; the outbuildings and fences are being whitewashed; rubbish is being removed from the yards; walks have been laid out from the doorway to the gate; vines begin to cover the unsightly features about the place, and general improvement is noticeable.

The above is only an outline of some of the more practical features of school gardening that have been introduced in the Columbia public schools, and does not include any reference to the important part that plant studies have taken in the written language work, in the lessons in physical geography, and in other exercises calculated to strengthen the powers of observation of the pupils and to bring them into a closer touch with nature. The success of this work shows that even school gardening can be introduced without in any way interfering with an overcrowded schedule, for the work was done by the teacher and pupils after school hours and on holidays. It was not a required work in any sense, and the only relation it bore to the class work of the school was to supply material for the class in botany, and to engender an added enthusiasm on the part of teachers and pupils.

The Flora of a Neglected Dooryard.

REV. J. M. BATES.

Long Pine, Neb., is situated about 20 miles east of the 100th meridian, and 35 miles south of the South Dakota line. It has an altitude of about 2,400 feet, and water is obtained at a depth of about 40 feet. The soil is a black, sandy loam, mixed with gravel and hardened with alkali. The subsoil is a mixture of clay and sand. The northern edge of the sandhill country has been regarded by some botanists as about the Western limit of the Eastern flora; but, as a matter of fact, no such limit can be definitely drawn, a few species ending all along from the Mississippi to the Missouri, and from the Missouri to the Black Hills, sometimes leaving gaps of several hundred miles, which may possibly be filled by closer observation. That such observations are needed now as in the past is shown by the fact that almost every year the known range of some plant is extended, some of the extensions equally astonishing Eastern and Western botanists. From the writer's standpoint, after ten years of study in this region, the most conspicuous fault in "The Illustrated

Flora" is its lack of recognition of these Western extensions of the range of Eastern plants.

It is with the hope of exciting some interest in this question, as well as in the natural grouping and succession of plants of this region, that I have prepared a list of plants growing on one occupied but neglected houselot in 1899. The season was of about average moisture, the precipitation being from 10 to 30 inches. The list is given in chronological order, because that has an interest of its own.

April.

1. *Peucedanum nudicaule* (Pursh.) Nutt. Abundant.

May.

2. *Carex stenophylla* Wahl. Very abundant; forming a large part of the sod.

3. *Prunus besseyi* Bailey. Accidental; common in the sand hills and useful for its fruit.

4. *Astragalus crassicarpus* Nutt. A few plants; common on the prairies, the fleshy fruit often eaten by cows and giving the milk a bad flavor.

5. *Allium nuttallii* S. Wats. A few plants; common on the prairies. Fifty miles to the eastward this species is replaced by *Allium reticulatum*, but it reappears further west, although I have never seen them growing together.

6. *Nothocalais cuspidata* (Pursh.) Greene. A few plants; common in the vicinity.

7. *Anemone caroliniana* Walt. A few plants; but making a flower garden of the prairie in spots, the flowers varying from almost white to deep blue.

8. *Erysimum repandum* L. About 200 plants; utterly unaccounted for. It is a native of Palestine and Syria and has heretofore been known only from ballast at Philadelphia and New York. It has been here at least four years, but diligent inquiry fails to disclose the manner of its introduction. The plant is an annual and seeds abundantly, but is not spreading perceptibly.

9. *Lappula texana* (Scheele) Britton. Abundant.

10. *Lepidium apetalum* Willd. Abundant.

11. *Gaura coccinea* Pursh. Abundant and beautiful; worthy of cultivation.

June.

12. *Psoralea esculenta* Pursh. A few plants; never abundant on these prairies. The "Indian turnip" of the West. The Sioux dig up the farinaceous roots in July and August and eat them as we do chestnuts.

13. *Plantago purshii* R. & S. Abundant; becoming a pest; forming large patches in unoccupied ground and giving a picturesque appearance to the landscape on account of its silvery-gray color.

14. *Bulbilis dactyloides* (Nutt.) Raf. Common, forming close mats.

15. *Festuca octoflora* Walt. Abundant on both wet and dry soil.

16. *Stipa comata* Trin. & Rupr. Common.

17. *Melilotus officinalis* (L.) Lam. Escaped and flourishing.

18. *Eriocarpum spinulosum* (Nutt.) Greene. Abundant.

19. *Tradescantia occidentalis* Britton. A few plants, mostly in sandy ground; long confounded with *Tradescantia virginiana.*

20. *Bouteloua oligostachya* (Nutt.) Torr. Abundant, forming a large part of the sod; confused with Buffalo grass.

21. *Koeleria cristata* (L.) Pers. Common.

22. *Pentstemon gracilis* Nutt. A single plant; common on parts of the prairie.

23. *Meriolix serrulata* (Nutt.) Walp. Common.

24. *Thelosperma trifidum* (Poir.) Britton. Common; a favorite with the children. It is either a biennial or short-lived perennial here.

25. *Helianthus petiolaris* Nutt. This and *H. annuus* occupy fallow fields for the first few years, the former taking the sandier ground and the latter the low, rich land. *H. petiolaris* is preeminently the sand-hill species.

26. *Schedonnardus paniculatus* (Nutt.) Trelease. Abundant. It is a perennial here.

27. *Malvastrum coccineum* (Pursh.) A. Gray. A common and beautiful plant.

28. *Hedeoma hispida* Pursh. Common but inconspicuous.

26. *Poa pratensis* L. A few tufts; sown on the sod years ago and surviving without watering.

30. *Bursa bursa-pastoris* (L.) Britton. A few plants; seldom as plentiful as *Lepidium apetalum.*

31. *Euphorbia glyptosperma* Engelm. Common on waste ground.

32. *Rosa arkansana* Porter. A small patch; our commonest rose outside of the canyons, blooming up to September 1st, this year.

33. *Sporobolus cryptandrus* (Torr.) Gray. Very common.

34. *Chenopodium leptophyllum oblongifolium* S. Wats. Abundant in unoccupied land. This form is not like that figured and described in the "Illustrated Flora," having invariably hastate leaves.

35. *Brassica arvensis* (L.) B. S. P. Only two plants, but common in grain fields.

36. *Delphinium carolinianum* Walt. Common on the prairie; the only larkspur of the region.

37. *Salsola tragus* L. Abundant everywhere, and though an unpleasant weed, no longer dreaded as a pest.

38. *Brauneria pallida* Nutt. Common on prairies.

39. *Eragrostis major* Host. Common everywhere.

40. *Amarantus blitoides* S. Wats. Abundant in limited areas.

41. *Portulaca oleracea* L. Common everywhere.

42. *Silene antirhina* L. Common only in the canyon.

43. *Opuntia humifusa* Raf. Several patches.

44. *Opuntia fragilis* Haw. Several patches.

45. *Polygonum aviculare* L. Abundant; blooming in November after zero weather; one can easily believe it to be perennial in some parts of the country. In alkali soil the blossoms are quite red.

46. *Polygonum convolvulus* L. A few plants.

47. *Chenopodium album* L. Common in the typical form; occasionally plants are found with green, edentate, scurfless leaves.

48. *Linum sulcatum* Riddell. A single plant. Until two years ago a small stable stood at the rear of the lot; and this plant, which belongs to the hay meadows of the region, was with several others undoubtedly introduced in hay.

49. *Agropyron occidentale* Scribn. Common on both high and low land; very valuable.

50. *Trifolium repens* L. A few plants surviving a sowing of several years ago.

51. *Chætochloa viridis* (L.) Scribn. Abundant, while *C. glauca* is quite rare.

52. *Allionia linearis* Pursh. Common in all dry soils.

July.

53. *Amarantus retroflexus* L. A few plants; very common in old gardens and fields.

54. *Amorpha canescens* Nutt. Common on sandy prairies.

55. *Elymus canadensis* L. Common on both dry and wet soils; one of "the survivals of the fittest."

56. *Panicum capillare* L. A weed everywhere.

57. *Agropyron tenerum* Vasey. A few plants only; belongs in the meadows.

58. *Secale cereale* L. Accidental.

59. *Panicum virgatum* L. A few plants; like *Elymus canadensis*, capable of growing on a variety of soils.

60. *Onagra biennis* (L) Scop. Two plants; usually on lower ground.

61. *Hordeum jubatum* L. A few plants; usually confined to borders of marshes. The plant is perennial here

62. *Saponaria officinalis* L. Well established and spreading from seed.

63. *Lotus americanus* (Nutt.) Bisch. Doubtless from the hay, as it is a plant of the meadows and canyons.

64. *Leptilon canadense* (L.) Britton. Common in both wet and dry soil.

65. *Lactuca scariola* L. A single plant; not seen elsewhere about town, but common ten miles west.

66. *Solidago missouriensis* Nutt. Our commonest goldenrod on the dry prairies.

67. *Aster multiflorus* Ait. Common in both wet and dry soils. The only species occupying the hard prairies.

68. *Ambrosia trifida* L. Accidental and rare.

69. *Grindelia squarrosa* (Pursh) Dunal. Two plants.

70. *Artemisia longifolia* Nutt. This and *A. gnaphaloides* are the only species fully at home on the hard, baked prairies, although *A. frigida* is sometimes found; usually, however, on looser soil.

71. *Ambrosia artemisiæfolia* L. A common weed.

72. *Laciniaria punctata* (Hook.) O. K. Very common; following *L. squarrosa.*

73. *Aristida basiramea* Engelm. A few plants, mostly on the gravel and sand.

74. *Cenchrus tribuloides* L. A few plants; not spreading much on firm ground.

75. *Portulaca grandiflora* Hook. A single plant, reproduced from seed planted several years ago.

76. *Polygonum ramosissimum* Mx. A few plants; common in waste fields.

77. *Panicum crus-galli* L. A few small plants; usually affects water holes and low, moist land.

78. *Andropogon furcatus* Muhl. Accidental from hay; belongs in low grounds.

79. *Verbena bracteosa* Mx. A few plants; common on such ground elsewhere.

Shorter Articles.

Notes on Wyoming Plants.

Below are notes on a few plants, found on the east slope of the Big Horn Mountains, near Buffalo, not generally listed as Wyoming plants:

Spirea betulifolia Pallas. Along streams in mountains. Collected July 30, 1898.

Tellima parviflora Hook. Very abundant in mountain valleys. July 3, 1898.

Linnaea borealis Gronov. Growing in pine forest at high elevation; abundant. August 1, 1898.

Douglassia montanum Gray. Near foothills; only one specimen, collected by a high school student; varies slightly from Coulter. May 12, 1899.

Nuphar polysepalum Engelm. Found in numerous subalpine lakes and ponds. August 20, 1898.

Gilia Brandegii Gray. Along a gravel flat bordering on Clear Creek. June 20, 1899.

Corallorhiza striata Lindl. In timber along Clear Creek, not far from foothills; several plants found, but only on one occasion. June 26, 1898.

Lilium Philadelphicum L. Reported as abundant in parts of Johnson County; I have seen only a few plants. Neglected to record date.

R. L. Hoff.

Buffalo, Wyo.

Among the Mycologists.

The Pennsylvania Mycological Society had an interesting course of study on fungi during the winter, closing May 1st with an instructive talk on the genus *Daedalea*. The summer will be devoted to field work.

H. S. B.

Mr. Thomas J. Keenan has recently published in the Proceedings of the N. Y. Mycological Club an interesting paper on the "Toxicology and Chemistry of Mushrooms." The author gives a resumé of our present knowledge of the chemical composition of the Fleshy Fungi, especially of the poisonous species, and urges more extended study of the subject on the part of botanists and chemists alike.

Up to the first of the present month there have been very few fleshy fungi owing to dry weather and the low temperature that followed the rain. All the species so far represented are:

Collybia platyphylla, Pholiota præcox, Pleurotus ostriatus, Clitocybe multiceps, Pholiota mutabilis, Amanitopsis vaginatus, Coprinus comatus, Panæolus campanulatus, Marasmius oreades, Naucoria semiorbicularis, Clavaria cinerea and Coprinus micaceus. None of these seem to have occurred in great abundance. There no doubt were others, but it is safe to say that, compared with other seasons, this has been unusally destitute of fleshy fungi.

It is not at all uncommon to find on various species of fungi, projections of greater or less dimensions on the top or edges of the cap, the under side of which bare gills and many times spore-bearing tissue. A specimen of *Collybia dryophila* was found not long ago in which the growth extended from the margin of the gills, and the minute gills borne on these projections were at right angles to the gills on which they were borne.

News and Notes.

In a recent number of the Trans. Acad. Sc. of St. Louis, Mo., Prof. A. S. Hitchcock publishes a second paper of his "Studies on Subterranean Organs," discussing "Some Dicotyledonous Herbaceous Plants of Manhattan, Kans." These studies are demonstrating the fact that there are many erroneous statements in manuals and other books on botany regarding the character of the underground organs of plants and are therefore of especial interest to teachers of botany.

A six-weeks' course in "Nature Study" is one of the attractions offered at the Marine Biological Laboratory, Woods Holl, Mass., during the present season. The course lasts from July 5th to August 15th, and will be in charge of eminent specialists in both branches of biology. It is designed especially for teachers, and the schedule of lectures gives promise of a veritable feast for those who are so fortunate as to attend.

Dr. P. Beveridge Kennedy, of the Division of Agrostology, United States Department of Agriculture, has been appointed associate professor of Botany and Horticulture in the University of Nevada.

Recent Literature.

The most complete work dealing with North American slime-moulds is the recently published work by Dr. Thos. H. MacBride, of the University of Iowa.*

This work is the result of years of careful and painstaking study of the slime-moulds in both field and laboratory, and is based upon extended collections of material from all parts of America. The author gives an extended bibliography of works treating this interesting group of organisms, and also an historical discussion of the classification, the habits and life history of the slime-moulds is quite fully discussed, and the author compares them with the fungi and lower animals, concluding his discussion of their systematic position with page 10. The term myxomycetes is used to include the parasitic forms as well as the endosporus and exosporus saprophytes. Some excellent hints are given regarding the collection and care of specimens, and carefully prepared keys are provided for each of the various groups; over 200 species, distributed among more than 40 genera, are described in the work, and the 18 plates with which it is illustrated are models of accuracy and artistic effect. The typography of the book is excellent, the binding strong, and altogether it is one of the best gotten up works that it has been our privilege to examine for some time. T. A. W.

There is no better indication of the progress of botanical thought in the United States than that so many of the foremost teachers of this science are devoting much of their energy to writing books designed to bring really up-to-date botany to the teachers and pupils of the public schools, in a live, attractive way. None of the writers of American text-books has a happier method of expression than Dr. J. M. Coulter, and his recent works will have much to do in influencing the trend of botanical activity in the secondary schools and colleges for the next decade. His two recent books, "Plant Relations," and "Plant Structures," have been brought together in one volume, entitled, "Plants,"* which makes one of a series of "Twentieth Century Text-books," edited by Dr. A. F. Nightingale and Prof. C. H. Thurber. While in the arrangement of the text, Dr. Coulter has placed "Plant Relations" first, he states in his prefatory note that "either part * * * may be used first, according to the views or needs of the teacher," although in the preface to "Plant Relations" he expresses a personal preference for ecology as a subject for beginners. The author urges the necessity for "independent teaching," and the "intelligent contact with plants," as the "essential thing." The text is delightfully written and arranged; the illustrations numerous, fresh and of excellent quality; and altogether the work is full of the breath of the field, and will do much to lead its readers into a close acquaintance with and enthusiastic study of "Plants."

---

*The North American Slime Moulds, being a list of all species of Myxomycetes hitherto described from N. A., including Central America, by Thos. H. MacBride, A. M., Ph. D., Professor of Botany in the State University of Iowa. The MacMillan Co., New York. Net, $2.25.

The "Suggestions to Teachers," written by Dr. Coulter, to accompany "Plant Relations," and by Dr. O. W. Caldwell, to accompany "Plant Structures," are bound in pamphlet form, and will be of great help to teachers in planning work for classes based on the new text-book.

T. A. W.

Editorial.

The marked progress which has been made in recent years towards a closer affiliation between the various State institutions and the scientific bureaus and divisions of the various departments of the General Government at Washington, is a most hopeful sign for the future. The Department of Agriculture, through its connection with the experiment stations and agricultural colleges, is doing much to advance these interests. The establishment of the system of "Scientific Aids" is one of the best moves that has been made in this direction, and can not help but bring the colleges and department into a closer touch, which will result in a great benefit to the aims and work of both. The graduate who receives an appointment as scientific aid, has, in effect, a fellowship which affords him rare opportunities for study in his chosen line, and to become familiar with its economic aspects to an extent not possible in a college or university; and at the same time he will show those under whom he is working his capabilities for the kinds of investigation demanded in departmental work. Thus the institution is benefited through its student, who receives enlarged opportunities, and the department is benefited by the better class of investigators which this arrangement makes possible to be obtained.

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*PLANTS, A TEXT-BOOK OF BOTANY by John M. Coulter, A. M., Ph. D., Head of Department of Botany, University of Chicago. D. Appleton & Co., New York, 1900. $1.60.

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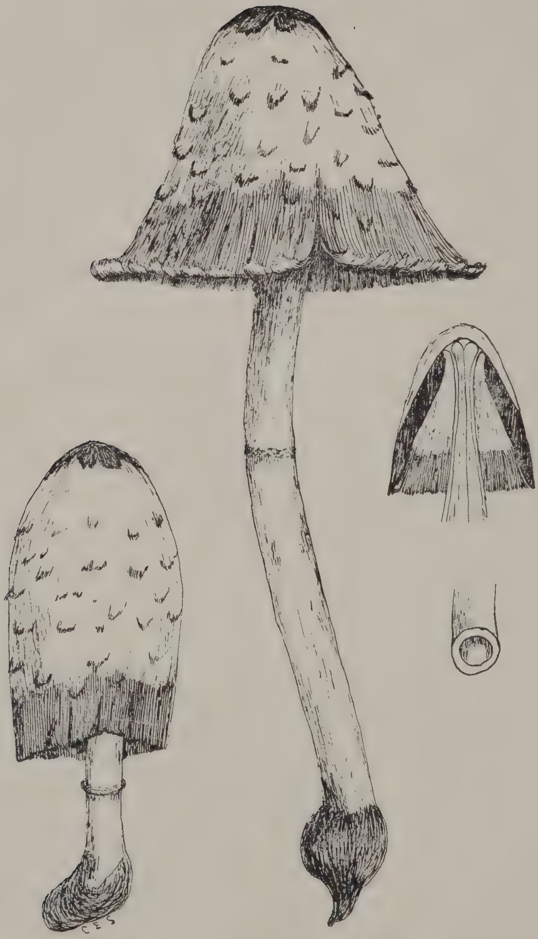

THE SHAGGY-MANE MUSHROOM.

Asa Gray Bulletin.

VOL. VIII. NO. 4. AUGUST, 1900. Whole No. 39.

The Shaggy-Mane Mushroom.—Plate IV.*

Because of the great abundance of individuals under favorable conditions and because of the delicate flavor of the edible sorts, the genus Coprinus ranks high among edible fungi. Moreover, for the beginner there is scarcely a safer group to attempt to identify, for the reason that there are none poisonous and few that are even suspected of being harmful. The genus is readily known by its most marked characteristic, the more or less rapid changing of the gills from a pure or pinkish or yellowish-white to a black deliquescent mass. All are of rapid growth and very perishable. The caps are unfit for eating after they begin to turn black, and as they do this very soon after reaching maturity, there is less danger of ptomane poisoning than in the less perishable kinds of mushrooms. They thus, by their disgusting appearance as soon as they have passed their prime, protect the eater against himself. When fresh, however, nothing can be more attractive-looking, and as the principal species are easily recognized, they should receive much attention from mushroom eaters.

Perhaps the handsomest and best-known species of this genus is *Coprinus comatus Fr., the "Shaggy-Mane"* mushroom. It is so called because the epidermis usually breaks up into small points, which stand out from the surface of the cap like a "mane," or, better still, resemble a poorly thatched straw roof. This

---

*COPRINUS COMATUS Fr. Pileus at first oblong or nearly cylindrical, becoming campanulate or expanded and splitting on the margin, adorned with scattered yellowish scales, whitish; lamellae crowded, white, then tinged with red or pink, finally black and dripping an inky fluid; stem rather long, hollow, smooth or slightly fibrillose, white or whitish, at first with a slight movable annulus; spores elliptical, black, .0005 to .0007 inch long.—*Peck, 48 Rep. N. Y. State Museum, p. 143.*

shaggy covering is to be found over the entire cap except at the center. Here the epidermis is generally unbroken, or, at least, much smoother than the rest of the cap. The margin generally begins to split longitudinally as soon as the cap attains full size and begins to expand. Young specimens are often of the purest white color, or they may have faint-grayish, or tawny or pinkish tints. In a fresh state they are always attractive-looking. The color rapidly deepens as the caps attain full size till at last it becomes of the inky blackness common to all species of the genus. The young caps look much like closed Japanese parasols and open out much slower than do most mushrooms. Often when growing in full sun the caps dry before the gills fully deliquesce, leaving the dried specimens standing erect, looking much like worn and ragged umbrellas, the split portions strongly suggesting protruding ribs.

Coprinus ovatus Fr. resembles *C. comatus* so closely that it is almost impossible to always separate the two species. No harm is done, however, if the two are confused, since both are equally good to eat.

The plants from which the drawings were made were found several years ago growing in great abundance in the mulch around young shade trees on the campus at the Agricultural College at Brookings, S. Dak. Many of the individuals were 9-10 in. high. In the vicinity of Washington, D. C., the species is common on lawns and parks, along the river and canal and in old pastures. In the pastures it is often found growing with *C. ovatus*, there sometimes being an excess of the latter species, particularly on high ridges and exposed hillsides, it seemingly being able to flourish with a less amount of moisture than is required by its relative.

The Shaggy-mane mushroom is often seen in the markets of Washington and is generally called "The French Mushroom" by the colored people who have it for sale, although the reason for this name is not apparent.

The species is common throughout the United States as well as all Europe, where it has been highly esteemed as an edible species since the time of the earliest writers on edible fungi.

It occurs in both spring and autumn, though generally more abundant in the latter season, sometimes growing solitary, sometimes in groups, and often in such great numbers that the earth is raised up in quite extensive mounds where the plants are about to appear.

The flavor of this fungus is not so pronounced as that of the common mushroom, although it is regarded by some as being more delicate. At least, it is good, and one of the tenderest and most easily digested of all mushrooms. It may be cooked in many ways, but is perhaps best stewed with butter or cream and pepper and salt. It needs to be cooked only a short time and should be kept covered that none of the savory juices escape. No water should be added, and if more juice is wanted than is supplied by the plant itself, rich milk or cream should be used. It makes an attractive dish if the stew be served on squares of toasted bread.

How to Review a Genus.

WILHELM MILLER.

The question is often asked, "Just how do you go at it to write up a genus for the Cyclopedia of American Horticulture?"

We begin with what we call the "trade lists." These are clippings from about seventy-five of the most important catalogues of plants offered for sale in America. The object is to account for these names. Sometimes half of them turn out to be synonyms or varieties, and many are very loosely or inaccurately used. Other cyclopedic works seem to have been worked up largely from conventional literary sources rather than from names actually current among tradesmen. For example, in the older books a rare genus is often compiled by copying a few lines from the Botanical Magazine, selecting the species that happen to be illustrated there. But these species we do not find advertised in the big European catalogues.

The first step is to "standardize" these trade names with Index Kewensis, incidentally noting the author of each species and the habitat. ("Standardize" is a diabolish good word, though Professor Waugh protests that it doesn't exist. It occurs, however, in bulletins of the Division of Soils, United States Department of Agriculture.)

The second step is to find the latest monograph. In beginning a genus it pays to accept the nomenclature of Index Kewensis, and to see a group through the eyes of the latest reviewer. Eventually one may smash them both, but this is the best way to start. Pinned to the trade lists is usually a memorandum of the latest botanical review of the genus. These data have been secured by turning over all the recent botanical publications in the Cornell University Library and making a card index of important recent monographs. If no memorandum exists, one turns instinctively to Bentham and Hooker's Genera Plantarum, where are exact references to all the important materials known at that period, 1873-76. Of the general works cited by Bentham and Hooker, by far the most useful in this work is De Candolle's Prodromus; of the periodicals, Curtis' Botanical Magazine; of the floras, those of Australia, India and the Cape.

The third step is to get as near the plants as possible. Drag out the dead plants and size them up. Now for life and color! If we have none of the plants growing in town, the next best thing is a lot of good pictures. Fastened to every bunch of trade lists is a stack of card references to pictures which represent two years of preliminary labor. This index covers everything worth while in the university library and in Professor Bailey's library. It is good fun to spread the pictures out on a big table, particularly if the plants are at all gloat-worthy, like Irises or Lilies or Poppies or Lady Slippers or Clematis or, indeed, pretty much anything. (All are good.) Right here, and now, comes the crucial test. A good man groups his plants almost immediately, and in a few minutes more he has the main outlines of his key. A weak man shuffles, and goes to a book. As if book dust would help! Louis Fuertes, a peerless bird painter, expressed the situation in this way: "You have to get right down and 'rubber' the birds." So with plants. There is only one way to get a good key—by direct personal contact. The conventional botanical key is no good for the busy gardener, florist or nurseryman, because it is based on dead plants, while the horticulturist cares for live ones. Of course, the herbarium characters are necessary also, but they should be worked into the specific descriptions, not into the key.

The rest is hard work, and every man to his own method. Professor Bailey uses any or all methods, or no method; usually the latter. He is too busy getting done to think about the best way. Allamanda he wrote in sixty minutes by the clock. It is an article of about 640 words, with eight good species and accounts for ten trade names. The plants are not merely described; they are distinguished. Eleven pictures were cited. Not less than twenty-five books were consulted. Four dried specimens were named. This was the first genus he tackled.

I come in on the freight myself. There are always two ways of doing a new thing, and I always choose the wrong one. Almost every student here who has tried a genus writes his descriptions first and gets his key afterwards. That is all wrong. It is too much like juggling book words, instead of displaying the goods, as if you had the bulbs to sell. Our point of view is the garden, not the world-monograph. Whenever S. W. Fletcher finishes a genus he wants to get all the plants right off and grow them in his own garden. I can always tell what is the best plant in his latest genus, because he wants to borrow money from me to buy it. I don't see how his article on Helianthus could be improved with the facilities he had. In that case Fletcher made his key first and then wrote his descriptions. The key is the most critical and discriminating part of the work. If there is any joy in the job it is in making the key.

There are tricks in all trades, and there is one in this delightful species of lock-smithery. There is a place where one can get suggestions for making a key that are worth a dollar a minute. It is "after the dash" in Bentham and Hooker. In each genus this dash separates the minute characters from the gross ones. After the dash come the big, striking things, thus: "Herbs or shrubs with large or small leaves, entire or toothed, and blue or yellow flowers in racemes or umbels." This is too easy, and the key makes itself something like this:

A. Plants, herbaceous, 1-3 ft. high.
B. Flowers blue.........................1. amabilis.
BB. Flowers yellow......................2. speciosa.
AA. Plants, shrubby, 6-10 ft. high.
B. Flowers blue..........................3. elata.
BB. Flowers yellow.
C. Inflorescence an umbel........4. grandiflora.
CC. Inflorescence a raceme.
D. Leaves small, toothed.......5. splendens.
DD. Leaves large, entire...........6. regalis.

Now, there is a reason for all this. One of the first things a cultivator wants to know about a novelty is whether it is an herb, tree or shrub. Next, why it is worth cultivating. Usually it is for the flowers. No one cultivates a plant because its leaves are entire or toothed, or large or small. He wants the flowers for their size, color, shape and number. So, too, the kind of inflorescence and the details of the foliage are usually incidental to the lover of plants as they grow.

When the key is made, the descriptions filled in, the pictures cited, all the names accounted for, and everything verified—then is a good time to write the popular and generic matter. In the Cyclopedia of American Horticulture almost every plant is described from three distinct points of view—popular, generic and specific. Here is an example: "Moraeas are pretty bulbous plants much like Irises, but not so hardy, and the flowers last only a day." That is a popular description. It means nothing to the botanist, but it is short, and it gives some idea of what the plants are like, and their relative horticultural value. Then follows the generic description, which I spare the reader. Imagine anything technical and unreadable which distinguishes this genus from all other genera. Later on the thirteen species are distinguished from one another. Thus each plant is described three times, in three places, from three points of view, beginning with the large things and ending with the small.

It is hard to keep down your feelings when you have your mind full of gorgeous Moraeas and are trying to write a sober opening paragraph. Moraeas are charming plants, anyhow. I never saw one, but if I can borrow enough from Fletcher this fall I am going to have at least one plant of *Moraea Robinsoniana.*

Variation from the Normal.

P. H. ROLFS.

This subject is a very interesting one, but rarely considered of sufficient importance to be worth recording. In America the larger portion of this work seems to have been delegated to the wideawake nurserymen, who are ever on the lookout for a novelty. The field lying between botany and horticulture is a rich one, and will bring abundant reward to those who may be so fortunate as to be able to occupy a portion. It is hoped that the following notes will prove to be of interest and value:

A White-Fruited Callicarpa.—Several years ago while collecting specimens of Callicarpa americana at Lake City, Fla., a fine, white-fruited bush was found. In other respects this plant could not be distinguished from the normal, or purple-fruited form. The berries in ripening changed from a green to an ivory-white, making a conspicuous and highly ornamental shrub, having only one fault; i. e., it was indigenous. This instance does not seem to be the only occurrence of albinism, for several times a similar condition has been mentioned to me.

White Blackberry.—About a mile southwest of Lake City, Fla., there is a field of these strange berries. It is extensive enough to permit the colored inhabitants to offer them on the market. The uncooked fruit is quite good, but strikingly different in flavor from the normal. Cooking it develops a slightly bitter taste, which makes it less desirable than the black blackberries.

There is a striking difference botanically between these two forms, though botanists uniformly refer both to *R. cuneifolius*, Pursh. The white-fruited form has fewer specimens with five leaflets; the leaflets average larger, the serration coarser, the stems and branches yellowish and the fruit yellowish-white.

Those who are acquainted with the species have no difficulty in sparating the two forms at any time of the year. There are reports also of this white blackberry occurring in other sections of Florida.

Occasionally there are plants in the field of an intermediate character as to fruit and general appearance. It is probable that this is a cross between the two forms. No specimens were discovered that would be classed between the cross and black form, or the cross and the white form. No attempt, so far as I know, has been made to cultivate this berry.

Double-Flowered Blackberry.—While mentioning blackberries, I am reminded of double-flowered specimens that have been brought to my notice here at Clemson College. They belong to the species *R. trivalis*. The number of petals vary from the normal, five to eighteen. It is an isolated patch of only a rod or two in area, but in this area the flowers show a decided preference for doubling. The petals occupy a normal position, but occur in two or three circles. Several of the stamens bear anthers of a foliar character, and others where no anther could be distinguished, the whole stamen being foliar in charăcter.

Doubling in Cornus florida.—Not far from the John C. Calhoun mansion is a tree of this species, with double "flowers." The white bracts are larger than usual and longer, five, six and seven growing in place of the normal number, four. The break in the normal number of bracts might prove a good lead for those who are fond of double "flowered" monstrosities.

Doubling in Violets.—A few rods from the Cornus tree referred to above grow double yellow violets (*V. hastata*). The throat of many specimens is filled with yellow petals and the stamens and pistils wanting. This would lead one to think that the freak was on a sure road to extinction, but on closer examination a cleistogamous flower was discovered, though this also seems abnormal, since the normal flowered specimens nearby produce an abundance of seed from the normal flowers.

Three-Spurred Violets.—During the last week of February, 1892, a specimen of *Viola muhlenbergii multicaulis* T. & G. was taken that bore flowers that were three-spurred. The petal that is normally spurred had an exaggerated spur, and the ones on each side a smaller spur. The filaments of the anterior stamens bore each a large spur projected into the spur of the petal. The two adjoining filaments bore smaller spurs projecting into the side spurs of the corolla. The three spurs were separated by sepals. It seems quite the usual thing for this plant to bear abnormal flowers.

Spotted Violets.—A few weeks ago a student brought to me a number of spotted violets (*V. cucullata?*). One or more of the petals had each a white spot, or sometimes two. The contrast with the deep violet of the petals is very striking, indeed, and should not be considered as an extreme example of variegation so common in this species. The spots are distinct and set off sharply.

Clemson Agricultural College,
Clemson College, S. C.

Shorter Articles.

Notes Upon Grape Mildew (Plasmopara viticola, B. & C.).

The grape vines upon the lean-to arbor at the rear of the old house at the College Farm have mildewed to a remarkable extent the present season. The Plasmopara was observed as early as the 10th of June, and then only seen upon the fruit, clusters which at that time were scarcely beyond the flowering stage. Shortly after, it was noted upon the foliage and particularly the stems.

The mildew appears to manifest itself first upon the flowers, and these seem to be the places of entrance of the fungus to the plant, and it spreads from there to other parts. The attack has been so severe that often the whole flower-cluster is involved and none of the pistils increase in size; but instead, they and their stems become first white with the rank growth of the conidiophores and spores and later turn brown and fall away. In other instances only a portion of the ovaries are attacked, and adjoining berries enlarge normally for a time, when they in turn become purplish and very hard, and then correspond to the ordinary condition of the "brown rot," that this mildew when upon the fruit is sometimes called. That the mildew spreads from one berry to another through the fruit-stalks seems evident from a study of the affected branches, where it is seen that the stalk first shows the disease, and then it next appears upon the basal end of the berry, which may be the only portion to show the conidiophores for a day or more before it covers the other parts of the berry. There is not usually much distortion of the mildewed parts, but occasionally the main axis of the cluster is bent and somewhat swollen.

The mildew often appears first upon the tendril of a sterile branch and seems to spread from there to the node, which often is white with the spores borne upon a purplish, slightly swollen stem. From there is seems to spread along the midrib of the leaf, there formed as shown by the contortions and white coating of spores, while the blade never fully opens and shows the mildew as a double irregular line of white upon either side of the main mediating ribs of the leaf.

That the disease remains over in the old canes seems probable from some observations, where the mildew had shown itself upon the surface at the first node of the new growth. It is possible that the disease reaches the flower-clusters through the soft tissue of the young stem instead of by spores through the air alighting upon the flowers and elsewhere. Possibly both methods are employed.

Many of the isolated spots upon the leaves would suggest that the infestation was from the air, while the large number of outbreaks at the nodes of the canes indicate that the hyphae of the fungus developed with the unfolding bud.

There are two species of grapes involved, the most susceptible being the one with a woolly leaf. The smooth leaved sort was about two weeks later in showing the disease, the reason for which is not easy to see; but possibly the foliage is not so porous. However, this reason should not obtain with the stems and fruit.

The fungus in question is admirably figured in plates 17 and 18 of Berlese's Peronosporaceae.

Byron D. Halsted.

Experiment Station, New Brunswick, N. J.

Among the Mycologists.

The long-promised book, "One Thousand American Fungi," by Captain McIlvaine and others, is out at last. It is published by the Bowen-Merrill Co., of Indianapolis.

Prof. H. H. Hume gives an account of "Some Citrus Troubles," in a recent bulletin (53) of the Florida Experiment Station, describing the principal diseases of these fruit trees occurring in Florida, and recommending remedies therefor. Some excellent illustrations of diseased plants and of certain fungi causing diseases elucidate the text.

Under the title, "The Smuts of Illinois Agricultural Plants," published in a recent bulletin (No. 57) of the Agricultural Experiment Station of that State, Prof. G. P. Clinton gives a large amount of valuable information, much of which is the result of original investigation of some twelve different smuts. Excellent illustrations, in the shape of reproductions of photographs of the affected parts of the hosts and photomicrographs and drawings of spores and mycelium of the fungi themselves, accompany the text and add much to the value of the publication.

In bulletin No. 107, of the Alabama Experiment Station, Prof. F. S. Earle gives an excellent account of the various fungous diseases of the cotton plant that have appeared in that State. A complete list of fungi recorded as growing on cotton or the cotton plant is given, and also a bibliography of the more important literature dealing with cotton diseases.

In the Bulletin of the Torry Botanical Club for May, Mrs. Flora W. Patterson describes a number of new species of fungi, most of which are parasitic forms from the United States, many occurring on greenhouse plants. Mr. Wm. A. Riley discusses "Variations in the Maturing of Plowrightia Morbosa Spores," and F. H. Blodgett records the finding of *Darluca filum* as a parasite on the carnation rust (*Uromyces caryophyllinus*).

In the Botanical Gazette for July, Prof. A. B. Cordley gives an interesting account of a new Anthracnose of the apple tree, occurring in the Pacific Northwest, and causing considerable damage, locally known under such names as "canker," "dead spot" or "black spot." He describes and illustrates the fungus under the name of *Gloeosporium malicorticis*, but in a note concludes that it is probably the same as a fungus described by Professor Peck, in the January number of the Torry Bulletin, as *Macrophoma curvispora.*

A recent number of "The Little Chronicle" contains an article on Fleshy Fungi, which is rather interesting in its way. In a column and a half, the attempt is made to describe two edible and two poisonous species and give remedies for poisoning. Three cuts illustrate the text. The writer closes with a description of the "Horsetail Mushroom," which, judging from the figure, is *Coprinus comatus*, although the description seems to indicate a cross between a morel and something in the author's imagination. The plant would certainly interest mycologists could they see it "in the flesh." Imagination may be very useful in a literary career, but its free use is not to be commended in a popular scientific article, and is little less than criminal in describing edible and poisonous fungi.

At a field meeting of the Washington Mycological Club, held at Tacoma Park, D. C., June 28th, after about one and one-half hours' hunt through a grove about one-half mile long and one-quarter mile wide, the collections were counted, showing sixty-five different species that were in workable condition, and about a dozen that were too poor to determine. The two genera best represented were *Amanita* and *Russula*, there being twelve species and varieties of the former and twenty-three of the latter. One specimen of *Amanita* and six of *Russula* could not be satisfactorily referred to any description obtainable. Since that time there has been almost no fleshy fungi found in the same region, although there has been considerable rain and much hot weather. For several weeks the conditions have seemed to be exactly right for Boleti, but there have not been more than six or eight species found, and only a few individual of each species except *Boletus felleus*.

Mrs. Mary Ream Fuller, corresponding secretary of the Washington Mycological Society, spent a month's vacation in the Indian Territory, and the following is an extract from a letter written from Wahpancka after an expedition to Sulphur Springs forty-five miles distant from that place: "Coming back, after a good hard rain, we camped in a deep wood on the edge of a ranch, and before the fire was kindled I had gathered enough of a Coprinus (not *comatus*, *atramentarius* nor *micaceus*, nor yet recorded in Herbst,* which is all I have with me) for supper (for 16), and before the supper was ready I had found *a grove of Lepiota procerus*, not less than forty magnificent specimens, all from ten to twelve inches in height, as straight and stately as young trees, in a space not 40 feet square, every one in its exact prime; not one an hour too old or young. Did we not feast? Every one ate and enjoyed, and I saved a few of the best for specimens. My little niece of 7 was with me when I discovered them, and at once exclaimed, "O, what pretty little doll parasols!" and they surely did look like it, for some were a foot high, and each had a decided umbo of dark brown, shaded down in flakes to nearly white on the silky edges, and each had a wide shiny silk ruffle around its stem about a third of the length from the top, while the stems were soft and shiny and closely covered with fine brown dots. Each specimen was simply perfect, and I hated to gather them or touch them in their quiet, stately beauty, far, far in excess of any flowers I have seen in many a long day. I also found puff-balls in many stages of color and growth, a few Boleti, and several specimens of what I supposed were *Collybia radicata*, but which were nearly twice the size of those described by Herbst. Coming across the prairies, we found a great big *Lepiota morgani*, fully 10 inches across, 9 inches high, and weighing at least half a pound."

E. M. W.

Recent Literature.

Prof. and Mrs. W. A. Kellerman have recently distributed an interesting paper on "The Non-indigenous Flora of Ohio," published as Series 4, No. 27, of the Bulletin of the State University. In their study of these plants the authors find that of 430 species not indigenous to Ohio, 326 have come from Europe; 30 from Asia; 2 from Africa; 21 from Tropical or South America; 46 from the Southern and Western United States; while there are five species whose native region is not now known. These plants make up more than 21 per cent of the entire flora of the State as at present known. In a subsequent number of the same publication Professor Kellerman publishes the "First Annual Supplement to the Fourth State Catalogue of Ohio Plants." This includes corrections of previous determinations, with a list of newly recorded plants, sixty-nine in all, and additional records of the distribution of Ohio plants by counties.

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*Mycological Flora of the Lehigh Valley.

The Department of Agriculture has recently issued a number of publications of great botanical interest and value. In Contributions from the U.S. National Herbarium (Vol. V, No. 5), Mr. Thos. H. Kearney, Jr., gives an excellent account of "The Plant Covering of Ocracoke Island; a Study in the Ecology of the North Carolina Strand Vegetation." In addition to a list of plants, with remarks upon their association into various plant formations and their adaptation to the conditions under which they are forced to vegetate, the author gives a detailed account of the structure of the most characteristic plants, a feature rather unique in the treatment of such subjects in American publications, and one which adds very materially to the completeness and scientific value of the work. "Stigmonose; a Disease of Carnations and Other Pinks," is the title of Bulletin No. 19 of the Division of Vegetable Physiology and Pathology, by Albert F. Woods. After an extended study and the performing of a large series of experiments the author comes to the conclusion that this disease is not of bacterial origin as was affirmed some years ago by Arthur and Bolley, but is due to the punctures of aphides, or plant lice, which bring about an increase of oxidizing enzyms that "interefere with the nutrition of the cells by destroying the chlorophyll and setting up other changes which finally result in death." The bulletin is illustrated by an excellent colored plate and a number of photomicrographs. "The North America Species of Bromus Occurring North of Mexico," have been revised by Mr. C. L. Shear, and the results of his study published in Bulletin 23 of the Division of Agrostology. Thirty-six species and twenty-eight varieties are recognized. Of the total number of species and varieties forty-five are indigenous. Three species and fifteen varieties are described as new, and *Neobromus* is proposed as a new subgenus for the group represented by *Bromus trinii* Desv. The article is illustrated by forty text cuts, showing habit-sketches and details of the structure of the spikelet. In "American Grasses, No. III," published as Bulletin 20 of the Division of Agrostology, Prof. F. Lamson-Scribner gives descriptions of the tribes and genera, with an illustration of a typical species of each genus. This work, while complete in itself, is also a companion and supplementary volume to Parts I and II of this series, issued some time since. It is one of the most valuable bulletins yet issued by this division, and will be found particularly useful to teachers and amateur students of this large and important group of plants. Another publication, written by a member of the scientific staff of the Department of Agriculture, but published in the Twentieth Annual Report of the U. S. Geological Survey, is entitled "The White River Plateau and Battlement Mesa Forest Reserves," by Geo. B. Sudworth, of the Division of Forestry. This is one of the most interesting and neatly gotten up works dealing with forestry problems of the country that has yet appeared. It is very profusely illustrated by reproductions from photographs taken in the field, which will be found exceedingly instructive to the student of the plants of the great Rocky Mountain region.

The first systematic attempt to record the flora of Oklahoma is made by Prof. E. E. Bogue, in Bulletin No. 45 of the Territorial

Experiment Station, under the title of "An Annotated Catalog of the Ferns and Flowering Plants of Oklahoma." In the introduction is given a brief statement of previously published records of plants found in the territory and the collections upon which the author bases his list. The catalog of species is accompanied by short notes upon the economic importance of the plants, the localities at which they have occurred, and the collector, when other than the writer of the Bulletin.

Prof. L. C. Corbett has recently perfected two execellent pieces of apparatus for use in the study of physiological botany. The one an improved auxanometer with a recording arrangement of great delicacy and accuracy; the other an apparatus for the measurement of moisture given off during transpiration. These are described at some length in the Twelfth Annual Report of the West Virginia Experiment Station, separates from which have recently been distributed.

In "Lessons in Botany"* Professor Atkinson has produced an "abbreviated and simplified edition" of his "Elementary Botany" reviewed in the *Bulletin* for February, 1899. The author states in his preface that the work "has been prepared for the use of pupils in the secondary schools, where short, or half year courses in botany are given," that "a large part of the matter has been rewritten, only the less technical descriptive portion being retained." The subject matter has been somewhat rearranged and several additions made which it seems to the writer make the work rather better fitted for elementary classes than the author's larger work, and it will undoubtedly be widely used in the high schools and other secondary institutions.

T. A. W.

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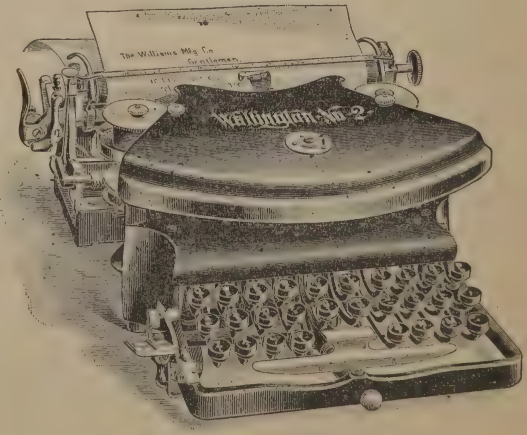

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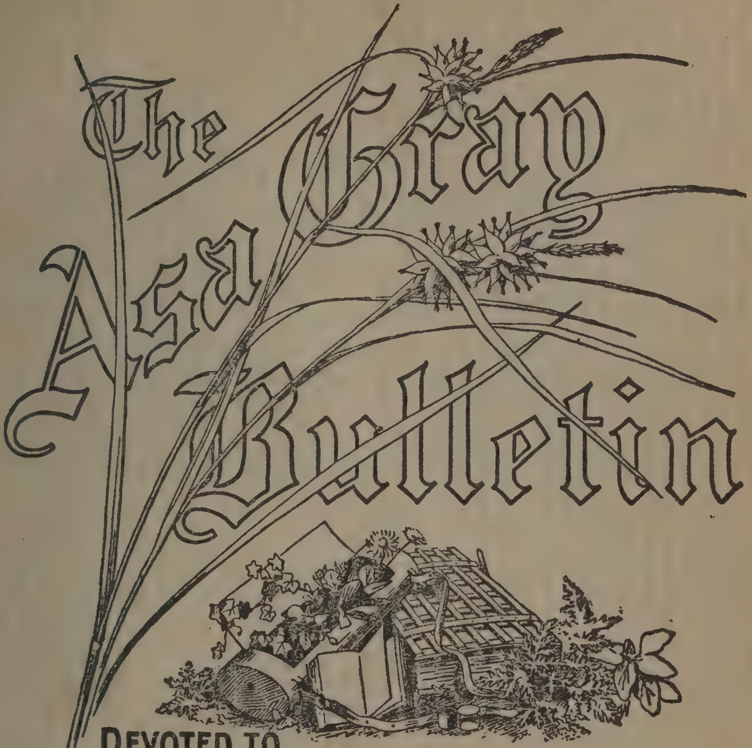

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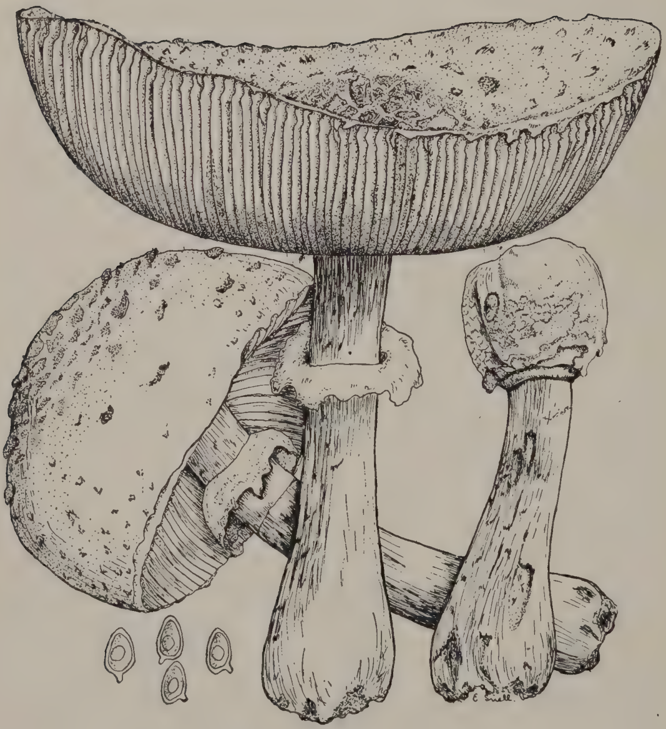

THE GREEN-SPORED LEPIOTA.

Asa Gray Bulletin.

VOL. VIII. NO. 5. OCTOBER, 1900. Whole No. 40.

Poisonous Properties of the Green-spored Lepiota—Plate V.

V. K. CHESNUT.

Most of us have been taught that any mushroom found growing amongst grass in open pastures is edible. The ill consequences of this teaching have during the past few years been most fully realized by dozens of persons in the middle West, especially in Ohio and the States which border on Lake Michigan, for in this region and in such a habitat the magnificent green-spored Lepiota (*Lepiota morgani*) grows to its largest dimensions, and from eating this enticing plant many have been made ill, some very seriously so, and now one fatal case has to be placed on record.

This plant was first described by Professor Peck* from specimens, notes and photographs furnished by Prof. A. P. Morgan of plants growing near Dayton, Ohio. The specific name, *morgani*, commemorates the name of the finder. In this description Professor Peck dwells particularly on one feature which most clearly distinguishes this fungus from all other known gill-fungi—its sordid green spores, these being readily distinguishable soon after the gills are first exposed to view, when they begin to impart their color to the gills, or after the cap has lain face down on a piece of white paper for a short while.

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*Lepiota morgani.—Pileus fleshy, soft, at first subglobose, then expanded or even depressed, white, the brownish or alutaceous cuticle breaking up into scales except on the disk; lamellae close, lanceolate, remote, white, then green; stem firm, equal or tapering upwards, subbulbous, smooth, webby-stuffed, whitish, tinged with brown; annulus rather large, movable; flesh, both of the pileus and stem white, changing to reddish and then to yellowish, when cut or bruised; spores ovate or subelliptical, mostly uninucleate, .0004 to .0005 of an inch long, .0003 to .00032 broad, sordid green. Plant 6 to 8 inches high, pileus 5 to 9 inches broad, stem 6 to 12 lines thick. Open, dry, grassy places, Dayton, Ohio.—Charles H. Peck, Botanical Gazette, Vol. 4, pp. 137-138, March, 1879.

Green-spored Lepiota is indeed a most descriptive and characteristic name for the plant. Even in dried specimens the greenish hue of the gills is prominent amongst the brown. In immature plants the spores are greenish-yellow.

This most striking feature, taken into consideration with the immense size of the pure white cap, which not uncommonly attains a diameter of ten, and sometimes over twelve inches, enables anyone to name adult specimens at a glance. The accompanying plate, redrawn in part, by permission, from a magnificent photograph of a series of the fungi taken under the direction of Dr. H. S. Pepoon, president of the Mycological Society of Chicago, shows the plant at various stages of growth. Its closest relative is the tall Lepiota, or "Parasol mushroom" (*Lepiota procera*), a popular favorite among mycophagists, and for which it has been mistaken. It has also been collected by mistake for the common meadow mushroom (*Agaricus campester*), and at least one person, whose family was poisoned by eating it, was of the opinion that they really had by mistake eaten the fly fungus (*Amanita muscaria*). It differs most conspicuously from all these in its green-colored spores and its greater size. While fully grown specimens of the fly fungus average from about 4 to 6 inches in diameter, these average from about 5 to 9 inches. The cap is also smoother and whiter than in all those just mentioned; one authority states that it can readily be seen for half a mile or more across a closely grazed meadow. The cap has no central knob-like projection and none of the shagginess of the tall Lepiota, neither is it so tall nor slender, and its flesh is not unchangeably white. The cuticle breaks up into easily detachable scales when the pileus is well expanded, but these are not so thick as those on the fly fungus, and the base of the stem has no stubby projections as in the case of the latter. The cap of the ordinary field mushroom has few, if any, warty patches that are easily brushed off, and, moreover, no mushroom but it has pink-colored gills, which change with age to blackish-brown. Another feature which strongly characterizes the green-spored Lepiota from all the foregoing species is its tendency to grow, like the fairy-ring mushroom, in huge circles, one of these, measured by Doctor Pepoon at Warren, Ill., being 16 feet in diameter. The plant does not, however, always occur in meadows, for it occasionally grows in the woods and on lawns. In wet seasons it may be found from spring to autumn, but it is specially abundant in August.

Lepiota morgani has been reported by Mr. McIlvane* from Kansas, Alabama, Georgia, Louisiana, Michigan, Texas, Ohio and Indiana, and, in addition, by correspondents of the Department of Agriculture from Washington, D. C., Indian Territory, Nebraska, Illinois and from Milwaukee, Wis. The belt, in general, coincides rather closely with the more humid eastern portion of the upper austral zone, as defined by Dr. C. Hart Merriam,† of the Department of Agriculture. It does undoubtedly extend into the lower austral, and perhaps into the transition zone also, but how abundantly has not yet been determined.

Little has been written concerning the edible or poisonous properties of this Lepiota. Prof. H. I. Miller, of Terre Haute, Ind., and Prof. W. S. Carter, of Galveston, Tex., have been quoted‡ on the subject by McIlvane. The latter concludes that the fungus "contains a poison which violently attacks some persons, yet is harmless upon others." Professor Carter cited the case of three laboring men who had been made seriously sick for a short time by eating it. Professor Miller stated that the meat is simply delicious, and that he and others, members of six different families, can eat it with impunity. He observed, however, that one or two of several of these families were made sick by it. Mr. C. G. McNeill, in an illustrated article published August 26, 1900, in the Milwaukee Sentinel, has called special attention to the danger of eating the plant. Through correspondence with the latter, the writer received details of four cases of poisoning, one of which was based on Mr. McNeill's own experience.

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*One thousand American Fungi, p. 38, 1900.

†Life Zones and Crop Zones of the United States, Bulletin No. 10; map, Biological Survey Division, U. S. Department of Agriculture.

‡ Ibid.

Aside from those above given, about twenty cases have been investigated by the writer, in all of which there is good ground for believing that *Lepiota morgani* was the cause of the trouble. These cases were in part reported by newspaper clipping bureaus, and partly through correspondence. Correspondence was instituted as soon as possible with the individuals concerned, and also with the physician who had charge of each case. The results of this inquiry have been tabulated, and will be reported on in full at some future time. A brief summary of the symptoms is herewith given.

Discarding a few doubtful cases, it has been found that the fungus has no disagreeable taste, and that the first symptoms come on about two hours after eating, being ushered in by an uncomfortable sensation in the stomach, similar to a slight attack of indigestion. Vomiting begins soon afterward and continues from three to five hours, after which an intense diarrhoea sets in and continues from several hours to a few days, the stools soon becoming thin and watery. These movements are generally unaccompanied by any pain or nausea, except during the most violent paroxysms of vomiting, but they are at times very painful. The patient is generally out of bed within twenty-four hours, but the feeling of languor consequent upon such an unusually heavy drain upon the system sometimes continues for several days.

The full details of the fatal case have not yet been ascertained, but are substantially as follows: The fungi were gathered in a pasture at Champaign, Ill., by the little four-year-old daughter of Mr. C., who, thinking they were the ordinary field mushrooms, offered them at about 2 P. M., on August 19th, to her little two-year-old sister. A still older sister soon afterward observed the child eating the fungus, and fearing that the specimens might possibly be obnoxious, stopped the child from eating any more, but was too late to prevent the swallowing of some of it. The amount eaten—which was, of course, raw—was not determined. Nothing was thought of the matter until about 4 o'clock, when the child began to vomit, first the fungi, and then mucus. Very shortly afterward the bowels began to excrete the characteristic thin, waterly stools. At 5 o'clock a physician, Dr. J., arrived, and found the patient cold, with scarcely any pulse, a correspondingly weak action of the heart, and so weak in general that she could not stand and could scarcely talk or swallow. Aromatic spirits of ammonia was freely and repeatedly administered, and, being extremely thirsty, she was induced to drink large quantities of milk. The child seemed at times to be in pain, so when the physician departed, a mild anodyne was left, which was to be given in case the pain became very severe. At this time the vomiting had ceased, the circulation was greatly improved, and the child was able to talk and swallow. The parents were directed to continue the use of the ammonia and milk. Before morning, however, the child began to have convulsions, and in spite of the treatment given by another physician (who, being more easily accessible than Dr. J., was called in), the child died at about 7 A. M., on August 20th. A large-sized specimen of the fungus, collected on September 5th, at the same place where the fatal mess was gathered, was sent by request to the Department of Agriculture, and identified by Mr. O. F. Cook and myself as the green-spored Lepiota. There can scarcely be any doubt that it was the same species as the one eaten. Dr. T. J. Burrill, of the Illinois State University, at Urbana, Ill., an eminent authority on botany, who was addressed for information in regard to the matter, states that he was thoroughly convinced from his own inquiry into this case, that the trouble was caused by the species in question.

The symptoms above given represent the two extremes; cases in hand present gradations, but the heart, which is so deeply affected in the more serious cases, was not, according to the careful observations made by a scientific and professional friend of the writer, affected in two of the minor cases. Severe abdominal and especially epigastric pain was present in two of the more severe non-fatal cases, and extreme diarrhoea and purging was present in all. The effect is probably always acute, but according to Dr. Burrill, there seem at times to be remote after effects, which are sometimes fatal.

The remedies thus far applied have been used empirically, for no pharmacological investigation of the fungus has been made. Morphine was used once with gratifying results, but in another instance it failed to give the relief hoped for. Strychnine and atropine were applied in two serious cases which terminated favorably, and in two others the administration of large quantities of milk was exceedingly gratifying to the patient. Rational treatment can, of course, only be expected after a thorough toxicological and chemical investigation has been made with the fungus.

Notwithstanding the clear-cut nature of the evidence in hand, showing that the plant does undoubtedly contain a poisonous substance, there are some persons who have eaten the fungus a number of times with impunity, and who also claim that it is delicious. The opposing views may possibly be accounted for by differences in the methods of preparing and cooking the fungus; to local differences in chemical composition; differences in the composition at varying stages of growth, but hardly to idiosyncracies in the persons partaking of the mess. In reviewing the cases reported, it seems most possible that the real explanation is the one suggested by Dr. Pepoon—that the fungi do not contain the poisonous substance when they are still in the unexpanded state. There is, however, some good contradictory evidence in regard to this point. The rapid change in color of the cut or bruised flesh is evidence that rapid, sweeping changes in chemical composition are likely to occur in the plant. With respect to the methods of preparation, it may be said that poisoning has resulted after frying, broiling, parboiling, discarding the cooking water, and then baking; and by cooking, in various ways, after having previously allowed the fungi to lie in salt water. The only fatal case reported was due to the eating of the raw cap.

In conclusion, I wish to acknowledge my obligations to the many persons who have supplied data on which the above outline was based, and to state that a pharmacological investigation of the fungus is being carried on by Dr. Pepoon and the writer. I would be pleased to acknowledge any communications giving further data in regard to the plant. Accounts or notices of cases of poisoning from the plant should be directed to the writer.*

U. S. Department of Agriculture,
Washington, D. C.

April in Northern Michigan.

MRS. JOHN M. MILLAR.

In our "north countree" King Winter bears sway for five long months, and we are not loth to exchange his reign for the gentle influence of the Spring Queen. Wisely she confers her favors on us, for should the birds and lovely blossoms come in rapid succession, we should, after the long season of ice and snow, with dearth of foliage and flowers, be quite overpowered by our riches; hence, first the robin comes as a scout for the summer campaign. His stay is brief, and not a sound do we hear of his inspiriting bugle-notes, but after a short, sharp encounter with the English sparrows, he is gone to return with his comrades in a few days. The sap begins to flow from the tapped maple trees, and freezing nights and thawing days, with an occasional rain or snow storm make prime sugar weather. The handsome red-headed woodpecker makes his first visit for his drink of sap and diet of worms. A week later, and dainty hepaticas, with pink, white anl lavender blossoms appear, and it is not rare to find them close on the edge of a snow bank. Merry parties of young people go to the hardwoods, and come home with baskets full of hepaticas, Dutchman's breeches, squirrelcorn, the frail white bloodroot, blue violets, the fragrant white violets, and the yellow blossoms of the dog-tooth violet. By the way, when will some botanist of authority come to the rescue, and give this plant a name more suited to its grace and beauty? It is now masquerading under a family name not its own. In the collection are white pink-lined spring beauties (*Claytonia virginica*). They wither sooner than many wild flowers, but will revive when placed in water, and the buds will expand day by day until the tiniest bud is unfolded.

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* Since writing the above account I have, through the courtesy of the editor, been enabled to photograph a large ring at Tacoma, D. C., which measured 33 feet in diameter, and have tested the juice of the fungus on a few rabbits. Through Dr. W. S. Moffatt, secretary of the Chicago Mycological Society, also, my attention has been called to a very important case of poisoning which occurred in that city. A lady member of the club cooked and ate three caps measuring from 2 to 2½ inches in diameter. The symptoms were about like those given above. A single cap, similarly prepared and eaten by her as an experiment a few days previous, caused no discomfort other than a slight nausea.

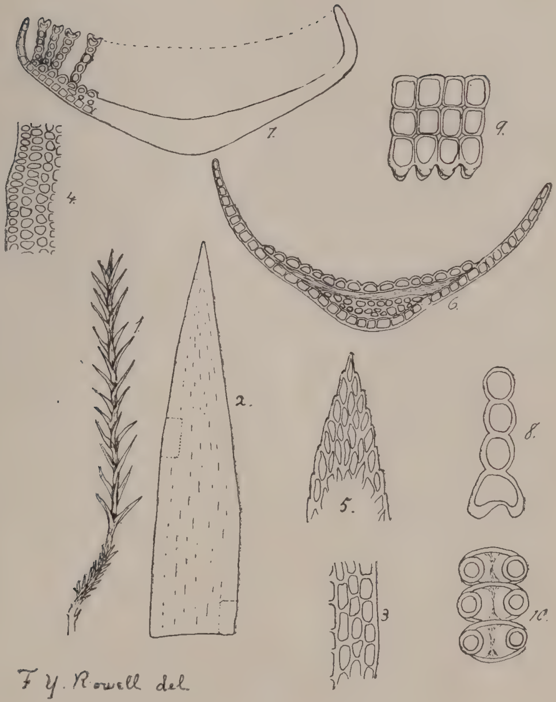
My own experiments show that four one-ounce feedings of the fresh juice are fatal to a rabbit weighing two pounds, and that the same feeding of the juice which had previously been raised to the boiling temperature was not fatal. The symptoms in the latter case were very mild and quite unlike those in the former case. The alcoholic extract which was prepared at the same time has not yet been tested. It may prove more fatal than the juice.

V. K. C.

Early in the morning, just outside our window, in his favorite maple tree, the song sparrow wakens us with his "lilting melody," filling us with the joy and wild tumult of hopes of days gone by, and this inimitably exquisite stanza comes drifting into our thoughts:

"Sweet bird! thy bower is ever green,
  Thy sky is ever clear,
Thou hast no sorrow in thy song,
  No winter in thy year."

April is preparing to resign her kingdom to May, when the trailing arbutus is in its full glory, blossoming in great abundance, and mingling its sweet perfume with the spicy incense of the piney woods. Several years ago I saw a group of young girls seated on the ground under the trees, with their laps filled with arbutus. They were cutting off the rusty dead leaves, shaking out the pine needles, and arranging the flowers in bou-



HOLZINGER ON POLYTRICHUM JENSENII.

Fig. 1. A plant of Nelson's Yellowstone Park material, nat. size. 2. A leaf in outline. 3. Cells from near the base of the leaf. 4. Cells from the margin near the middle. 5. Cells from the apex. 6. Leaf-section near base. 7. Leaf-section near middle. 8. Cross-section of lamella. 9. Side view of a part of a lamella. 10. End view of three terminal cells of a lamella, showing papillae. (Figs. 3, 4, 5, 8, 9, and 10 are much enlarged.)

quets, when a snowstorm came up—not one of Emerson's kind, "Announced by all the trumpets of the sky," but one after Longfellow's description—"Silent, and soft, and slow;" and at once there was a picture always to be remembered—lovely, smiling faces, wreaths of pink arbutus blossoms, large, feathery snowflakes, with pines and hemlock forming the shaded background.

The Mayflower is followed by a lavish growth of other wild flowers, and a great variety of ferns, on fertile soil and sandy plain. The seagull's cry overhead proclaims that the ice is moving out of Green Bay and Lake Michigan, and that soon the immense fleet of ore-carriers will commence the season's traffic.

One April morning in '96, when buds had begun to swell, and the grass, chameleon-like, was turning from brown to green, a curious and beautiful panorama greeted our eyes. The branches of every tree were swaying in the wind with fringes of icicles. Vines, swinging from the veranda roof, were encased in transparent sheaths, and the few berries left on the woodbine were each enclosed in a glass case, with crystal pendant, that reminded us of the pretty prisms on the candelabra that we used slyly to jingle with a touch in grandma's dark parlor. The partly formed catkins, on the aspen-leaved poplars, looked like half-drowned mice, instead of the "soft fuzzy pussies," that to a child are like an olive branch after our long winter. Blades of grass and every thorn on the rose bushes bristled with tiny icicles, while window-ledge and prosaic clothes line were decorated with tasseled fringe. The tall Lombardy poplars looked like great waving white plumes, and when the sun shone out they were seen tipped with spangles glistening in the light.

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A Polytrichum New to North America—Plate VI.

PROF. JOHN M. HOLZINGER.

While collecting in the Yellow Stone National Park, during the season of 1898, Prof. Aven Nelson discovered on the shore of Beaver Lake a curious Polytrichum, of which only sterile plants were found. The structure of its lamellae seemed to relate it to *P. commune*; but leaf margin, leaf apex, and the disposition of the leaves when moist seemed to indicate that the plants represented a distinct species, at least, not any species known to exist on the North American continent.* So the writer submitted the plant to Dr. Best, for further critical examination. A correspondence followed, in which strong arguments were developed, tending to establish the hypothesis that the plant in question is simply a monstrosity, a diseased form of *P. commune.* The fragile leaves and the pale green color of the young growth of plants certainly afforded a strong suggestion in this direction. The plants were therefore submitted to several mycologists for examination, namely to Mr. E. W. D. Holway, to Mr. J. B. Ellis, and to Dr. Halsted. The results of these special examinations were rather negative. It is true, a saprophytic growth, a kind of mold, was recognized by Mr. Ellis; but he pointed out that this could not have affected the character of the living plant.

Mrs. E. G. Britton, to whom the plant was also submitted, suggested that it might be *Polytrichum beringianum* Lindb., from the description, but that there was no authentic material of this species at hand. The only thing to do, therefore, was to get from the author himself some typical *P. beringianum.* Accordingly the writer laid the plant before Dr. Lindberg, asking at the same time the privilege to see one or two plants of *P. beringianum.* These Dr. Lindberg generously sent, but on examination they proved quite different from Nelson's *Polytrichum*; in fact, they seem to the writer indistinguishable from *Pogonatum alpinum*, with which they have in common the elongated, slightly papillose cells of the lamellae. Dr. Lindberg at the same time kindly examined Nelson's plants, and pronounced them to be *Polytrichum jensenii* Hagen.

There now followed some correspondence with Professor Harold Lindberg, and with Dr. I. Hagen, fully corroborating the identity of this American with the North European plant, thus establishing another case of unusual geographical distribution.

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*The terminal cells of the lamellae are also distinctive, being 24 microns wide, while in P. commune they are only 16 microns.

By permission I quote from Dr. Hagen's letter:

"Your plant is more green, with more shining leaf bases than those from the other two localities, but in essential characters it agrees thoroughly with them. A character not mentioned in the original description, because hardly observable in the Greenland specimen, is very conspicuous in both your (Nelson's) plant and the Finnish one; at the point of transition between the sheathing base and the lamina there is to be seen on each side of the nerve a dark brown dot, caused by shrinking; at this point the leaves break off easily. In the Finnish plant all leaves of the lower part are broken, and here the stem is covered by the remaining bases only.

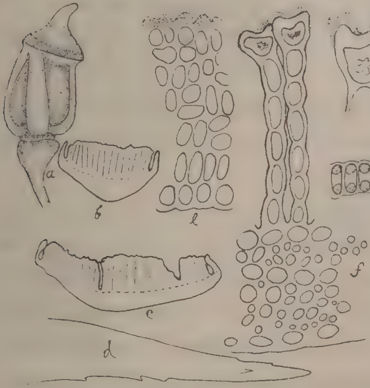

Fig. 1. POLYTRICHUM JENSENII HAGEN.—*a.* Capsule, natural size. *b. c.* Leaf sections in outline, x35. *d.* Leaf apex, x35. *e.* Side view of a piece of lamella, x190 *f.* Cross section of two lamellae attached to leaf, x190. *g.* Same view of terminal cells of a lamella, x330. *h.* Top view of part of lamella, x190. (Redrawn from sketches by H. Lindberg, made from the type material of his *P. fragilifolium.*)

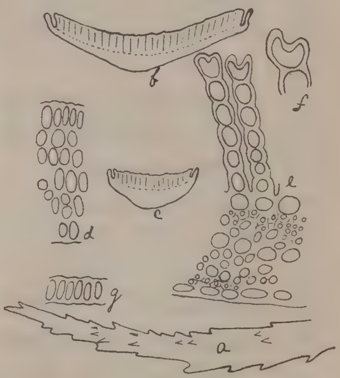

Fig. 2. POLYTRICHUM COMMUNE L. *a.* Leaf apex, x35. *b. c.* Leaf sections in outline, x35. *d.* Side view of a piece of lamella, x190. *e.* Cross section of two lamellae attached to leaf, x190. *f.* Same view of terminal cells of lamella, x330. *g.* Top view of part of a lamella, x190. (Redrawn from sketches made by H. Lindberg from plants collected in "Isthmus Karelicus.")

"There is described from ancient time, a *Polytrichum propinquum* R. Br. ('Caule simplici elongato, foliis margine serrulatis dorso laevibus. Obs. Species absque fructificatione haud determinanda, a *Polytricho communi* satis diversa videtur'), that has been considered by Bridel and his transcribers as a synonym of *P. commune.* I am convinced, however, that it is not so, but I can not decide whether it is the same as my *P. jensenii*, because there are other arctic Polytricha, to which the scanty description of Robert Brown may be applied."

To this suspicion of Dr. Hagen, regarding the relationship of R. Brown's species, the writer ventures the suggestion that the brief description of *P. propinquum* seems to apply better to *P. ohioense* than to *P. jensenii*; but, of course, to neither plant with certainty.

To Prof. Harold Lindberg is due the credit for compiling the synonymy of this plant, who sent it in a recent letter together with the following note:

"A description of *Polytrichum fragilifolium* is not yet printed. I gave the name the 26th of June, 1897, and announced the moss as species nova at a meeting of the Societas pro Fauna et Flora Fennica, on the 5th of March, 1898. The protocols from the meeting are not yet printed, but I hope that they will soon be. I send you some figures which I have made of *P. fragilifolium.* This is quite identical with *P. jensenii* Hagen, in Meddelelser om Grönland, XV, 1898. I send you enclosed a copy of the description of P. *jensenii.**

"In the herbarium of L. O. Lindberg lies the same moss, * * * * with the following note:

"Folia erecta, stricta, dorso valde convexa, marginibus involutis, sed non-conniventibus, integerrimis, cellula limbati lamellae pulcherrime semilunata. Ideoque *P. juniperinum* marginibus involutis integerrimisque aliquantulum vertat (4 Nov., 1872)."

"This specimen was found in 'Lapponia orientalis, locis paludosis ad pagum Ponoj, inter Sphagna sparsim crescens, 1872,

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*The writer has also to thank Dr. Hagen himself for loaning him the only printed copy in his possession.

VIII, by Dr. V. F. Brotherus. In Musci Lapponiae Kolaënsis, p. 44, Dr. Brotherus referred to this plant mistakenly as var. *integrifolium* Lindb."

Prof. Harold Lindberg allows that Dr. Hagen's specific name, as being the first name duly published with full description, is the right name for this plant. The synonymy therefore stands as follows:

1. *Polytrichum jensenii* Hagen in Meddelelser om Grönland XV, p. 444, 1898.

2. *Polytrichum Cubicum* Lindb., var. *integrifolium* Broth. (non Lindb.), in Musci Lapponiae Kolaënsis, p. 44, 1890. Acta Soc., p. Fauna et Flora Fennica, VI. (This, under *P. commune* L., of which *P. cubicum* was regarded as a subspecies.)

3. *P. fragilifolium* Lindb., fil. mss., 26th June, 1897, et apud Soc., pro F. et Fl. fenn., 5 Mar. 1898. (Ined. Oct., 1900.)

The type material on which Dr. Hagen bases *Polytrichum jensenii* was collected in 1887, near Agpalisiorfik, Northwest Greenland, by Ussing, on the Ryder expedition. Dr. V. F. Brotherus, however, collected it as early as 1872, in Eastern Lapland, as is shown above by Prof. Harold Lindberg. The plants on which the latter based the description of *P. fragilifolium* were collected by himself in 1897, on the "Isthmus Karelicus," on the sandy shores of Lake Suvanto and Lake Vurksen, in Finland. Professor Lindberg also reports finding this species in the herbarium of the University of Helsingfors, where it was under the name *Polytrichum commune.* The specimens were collected by Prof. S. Berggren, in 1868, at "Ameerenberg, Insulae Spitzbergenses." Finally, Prof. Aven Nelson has found the plant in Yellow Stone National Park, in this country.

State Normal School, Winona, Minn.

Among the Mycologists.

The Pennsylvania Mycological Society held its first autumn field meeting on September 22d, in connection with the other botanical societies of Philadelphia. Owing to the dry weather the fungi were scarce and the results of the meeting consequently rather disappointing. H. S. B.

The officers of the Chicago Mycological Society are evidently doing their full share of work in that organization. At the first meeting after the July and August vacation, the president, Dr. Pepoon, exhibited pen-and-ink sketches of seventy species found during the summer, while the secretary, Dr. Moffatt, read a list of over a hundred species which he had identified and preserved, either by drying or in formalin.

Mr. A. S. Bertolet, of the Chicago Mycological Society, who has studied the higher fungi in Northern Michigan, during the summer, has started for the mountains of North Carolina, where he will collect during autumn, after which he will go to Florida for the winter. Last winter he sent from that State specimens of the rare *Myriostigma coliforme* Dicks, which was found in abundance in sandy soil under evergreens, near New Smyrna.

In a practical paper upon edible and poisonous fungi, published in the Year Book of the Department of Agriculture, for 1897, Dr. W. G. Farlow wrote: "Avoid fungi when in the button or unexpanded state."

The neglect of this simple precaution resulted not long since in the poisoning of seven persons in a family near Chicago. Three of the cases were fatal. The plants were collected by a farm hand, who had for years been in the habit of gathering them for use upon the table of his employer. Among those which caused the poisoning were "half a dozen buttons," as he remarked when he brought them in. These were in all probability *Amanita phalloides*, as specimens of that species were afterwards found by botanists of the Chicago Mycological Society, in the woodland pasture where the fatal fungi were gathered.

At the risk of giving the publishers a little gratuitous advertising, I wish to commend to mycological students the little book entitled, "Moulds, Mildews and Mushrooms," by Prof. L. M. Underwood, of Columbia University. It is scientific, practical, up to date; by a man who knows how to condense, and who has the somewhat rare gift of knowing what to say and what to leave unsaid. It is not written for those who are interested in knowing that a certain *Clavaria* can be eaten if "chopped fine and stewed slowly for an hour," or that the "awl-shaped teeth of an *Irpex* are detachable, and food-giving," but for the earnest worker in fungi who has hitherto had no one book in the English language to which he could refer, either for a systematic view of the families of these plants, or for references to the literature of this country and Europe. W. S. M.

Through the active research being carried on by Professor Nelson and his assistants, Wyoming, although a large State, with extremely varied conditions, will soon be one of the most thoroughly known botanically of any of our Western States. In a recent publication (Tenth An. Rep. Wyo. Exp. Sta.) is given a list of the cryptogams, exclusive of the ferns, that have been collected by Professor Nelson and his assistants or that have already been published as occurring in that State. The list is only a preliminary one and will be made the basis for further study.

Up to the present time students of American botany have not paid a great deal of attention to the systematic study of the fleshy discomycetous fungi, except for the occasional description of new species. In the Torrey Bulletin for September Dr. E. J. Durand publishes an article on "The Classification of the Fleshy Pezizineae With Reference to the Structural Characters Illustrating the Basis of Their Division Into Families," in which he gives an historical discussion of the various systematic arrangements of the groups, followed by studies in the morphology of representative forms in each of the four families, and closes the paper with a synopsis of the families and genera and a bibliography of works dealing with these fungi. The paper will be a useful one to students of the Discomycetes, and it is hoped that the author will continue the work to a similar study of the species found in this country.

In Part IV, Series II, of the Minnesota Botanical Studies, issued on August 15th, C. S. Scofield publishes "Some Preliminary Observations on Dictyophora Ravenelii Burt," which consists mainly of a study of the structure and morphology of different stages in the development of the fungus as represented by material collected near Minneapolis, Minn. The article is illustrated by three excellent plates, two of which show the appearance of the fungus as it grows in nature, while the third gives the structural characteristics of the plant.

In a recent publication of the Department of Agriculture (Bull. 21, Div. Veg. Phys. and Path.), Dr. H. von Schrenk has given the results of his study of two diseases of Red Cedar caused by fungi. One of these diseases, known as "White Rot," is caused by a new species of Polyporus (*P. juniperinus* von Schrenk). The mature fungus seems to be rare, having been collected but twice, "once in 1895, by Miss Sadie F. Price, at Bowling Green, Ky.," and once by Dr. von Schrenk at Murfreesboro, Ky. The other disease, known as "Red Rot," or "Pecky Cedar," is due to *Polyporus carneus* Nees and is much more common than the white rot. Descriptions of the various stages of each of the diseases are given, and three figures and seven excellent plates illustrate the bulletin.

The current number of the American Kitchen Magazine has an unusually good mushroom description by an amateur and written for other amateur fungus collectors. The fungus described is *Marasmius oreades*. The characterization is so well drawn that if closely followed one could hardly make a mistake. When one compares an article of this kind with the popular descriptions of mushrooms seen in many periodicals the wonder grows that more writers do not use their eyes and pens to better advantage or leave the subject to those who better understand the subject. In the current number of The Woman's Home Companion, in the "Answers to Inquirers" the editor wisely declines to give information as to "how to distinguish a mushroom from a toadstool," saying she was "unwilling to take the risk." If such frankness were only more common, there would be fewer newspaper accounts of mushroom poisoning.

The unusually hot, dry weather prevailing at Washington during the greater part of the summer put a severe check on nearly all fungus growth. The recent warm rains are now bringing out the summer as well as the fall species all at once. Within a few days, in an area of half a mile square, without any special search, the following species of Amanita were found, most of them growing in a pine grove covering about six blocks: A species previously doubtfully referred to *A. caesaria*, which, though quite similar in appearance, is without doubt as yet undescribed; *A. pellucida*, abundant; *A. phalloides*, only a few plants; *A. pantharina*, sparingly; *A. muscaria*, abundant, both in the typical and in the pure white forms; *A. frostiana*, or what has generally been called that species, but is probably two nearly related species or a species and a well-marked variety; *A. russuloides*, sparingly; *A. candida*, one specimen; *A. solitaria*, occasional; *A. monticulosa*, about half a dozen plants; *A. chlorinosmia*, quite abundant and unusually large; *A. rubescens*, very large and in great numbers, both in the typical warty form and with the cap almost destitute of warts and often more slender and paler, and, except for the volva, so much like forms of *A. phalloides* that it is difficult to distinguish them, there often being almost no red or brownish stains on the stem; growing with the typical *rubescens* is often found a smaller plant closely resembling it in many ways, but with orange or yellow warts and collar and with floccose-yellow marks on the stem; *A. vaginata*, in greatest abundance, not only the common, blue-gray form, but also the yellowish form, and sometimes the pure white one as well; *A. velosa*, in great abundance, resembling *russuloides*, but entirely destitute of a collar, quite viscid and with great doubt referred to the above species, since the volva is not as in that species, but, while always in evidence, is very fragile and separates from the top of the bulb at the slightest touch; *A. volvata*, sparingly; *A. farinosa*, only a few specimens. A more extended search would probably have added *A. recutita*, *A. virosa*, and possibly, *A. mappa*, *A. candida*, *A. strobiliformis* and *A. strangulata*, since all have been found within these limits. With the exception of *A. muscaria*, *A. phalloides* and *A. vaginata*, the amanitas are usually rare in this locality after the 1st of September.

E. M. W.

Recent Literature.

English-speaking students and teachers of botany will hail with delight the translation of Dr. Goebel's "Organography of Plants," now being issued.* The present volume, which deals with "general organography" is divided into five sections, with the following titles: General differentiation of the plant-body; relationships of symmetry; differences in the formation of organs at different developmental stages; malformations and their significance in organography; the influence of correlation and external formative stimuli upon the configuration of plants. Dr. Goebel has for years been an acknowledged authority on plant morphology, and his well-known views on the subject will now be much more accessible to students in this country, many of whom are already familiar with the German edition of his work. The work is a peculiarly suggestive one, setting the student to thinking in a way that can not but result in a better understanding of the problems presented. The spirit of the work is indicated in the following from the author's preface: "All the phenomena of life have a definite relationship to environment, and, therefore, as I shall endeavor to show in this book, the consideration of the configuration of the organs of plants is not merely a comparative historical criticism, but must take into account all the conditions of environment which we find at the present day. Morphology has to determine in what degree the formation of organs shows an adaptation to external relationships, and to what extent it is dependent upon these and upon internal conditions; and even if the subject be studied from the purely phylogenetic standpoint, such determinations are a necessity, inasmuch as the historical development would be constantly influenced by environment. Phylogenetic speculations are doubtless more attractive than the grappling with the facts, often obscure and apparently insignificant, of the relationships of configuration of the plants around us. It appears to me, however, that to recognize the factors which bring about development of, say a leaf with one side larger than the other, is infinitely more important than to construct a phylogenetic hypothesis unsupported by facts." As Dr. Balfour remarks in the prefatory note to the English edition: "Some of the interpretations and views to which Professor Goebel gives expression may not find unqualified acceptance; but the criticisms they will evoke and the experimental research which is sure to be stimulated by the author's suggestive statement of problems requiring solution, should further in no small degree the progress of our knowledge of the phenomena of life exhibited by plants." T. A. W.

---

*Organography of Plants, especially of the Archegoniatae and Spermaphyta, by Dr. K. Goebel, professor in the University of Munich; authorized English edition by Isaac Bayley Balfour, M. A., M. D., F. R. S. Part I. Clarenden Press, Oxford, London, Edinburgh, and New York. Price, twelve shillings and sixpence ($3.10).

Notes and News.

Among catalogues recently received those of Thomas Meehan & Sons, of Germantown, Pa., and the Pinehurst Nurseries, Pinehurst, N. C., appeal especially to the true lover of plants. The use of photographs for illustrations is especially noteworthy, and one looks through such catalogues with a sense of rest and enjoyment, after the flood of gaudy things glaring from the pages of the pamphlets distributed by so many seedsmen and nurserymen. In these catalogues one is not met on every hand with glowing descriptions of the plants offered for sale, but with plain statements of their habits, character and uses and good reproductions from nature. The Meehan publication, particularly, is well worth reading, for it is more than a catalogue, containing much valuable information, as it embodies the results of years of deep and loving study of plants, their habits and peculiarities.

At a recent meeting of the Philadelphia Horticultural Society there was a particularly fine display of Orchids and Dahlias. Of the former two Dendrobiums and a Cypripedium are most worthy of mention. Of the latter fine plants were shown of such varieties as Clifford W. Bruton, perfect form and of finest canary yellow; Crimson Giant, a very large-flowered sort; Fire Flame, orange buff with scarlet edge; Grand Duke Alexis, pure white with tinge of pink; Prince Alexander, pink striped with red; Ethel, large yellow, tipped with white; Maid of Orleans, Storm King, Queen of Yellows, and many others.

H. S. B.

Botanists and all lovers of "Outdoors" will read with interest and profit Professor Holzinger's excellent account of "Lake McDonald and Vicinity," published in the Bulletin of the American Bureau of Geography for September. This region, lying in Northwestern Montana, has been easily accessible only in comparatively recent years, and is well worth visiting by those who enjoy camping and mountain-climbing.

Two of the eight lectures advertised by the Field Columbian Museum in the free lecture course for the autumn of 1900 are on botanical subjects. One, delivered on October 6th, by Dr. C. R. Barnes, is on "How Plants Live." The other, on October 27th, by Dr. T. H. Macbride, on "The Life and Death of a Tree."

In Bird-Lore (The Macmillan Co.) for October Captain Gabriel Reynaud concludes his account of experiments made while establishing the homing pigeon service of the French army; A. J. Campbell, of Melbourne, describes the remarkable habits of the Bower-birds of Australia and illustrates his paper with photographs from nature of the singular structures erected by these birds,; Olive Thorne Miller describes her methods of teaching popular ornithology, and Ernest Seton-Thompson writes of a growing superstition in Paris against the wearing of aigrettes.

The efforts being made by several of the horticultural societies to interest the young people in the cultivation and field study of plants are to be commended and should receive the hearty support of teachers and parents. Perhaps no society is doing more in this direction than that of Massachusetts, which has for some time offered prizes for school gardens and school and children's herbariums, holding regular exhibitions for the purpose at Horticultural Hall, No. 101 Tremont street, Boston.

Dr. B. D. Halsted has recently published as a bulletin (No. 144) of the New Jersey Experiment Station a charming article on "Live Covers for Country Homes." The author discusses a large list of plants suitable for use as "live covers," and tells through text and excellent illustrations how they can be employed to best advantage. He deals with the abuse as well as the use of these plants, closing with a sentiment that should be in the heart of every teacher and parent—the stimulation of a greater love for and a proper use of plants for the external adornment of the home and an appreciation of the possibilities for artistic home improvement that lie within the reach of the poorest farmer in the land.

A book on edible and poisonous mushrooms is promised soon from the pen of Dr. Geo. F. Atkinson. About 200 species will be described, and the work will be illustrated by 200 half-tones from photographs, 70 being full-page plates. In addition 15 species will be reproduced in colors. The book will also contain chapters on the collection and preservation of mushrooms; preparation for the table, and keys to the orders and genera. Mrs. Rorer will contribute a chapter on cooking mushrooms, and J. F. Clark one on toxicology and chemistry.

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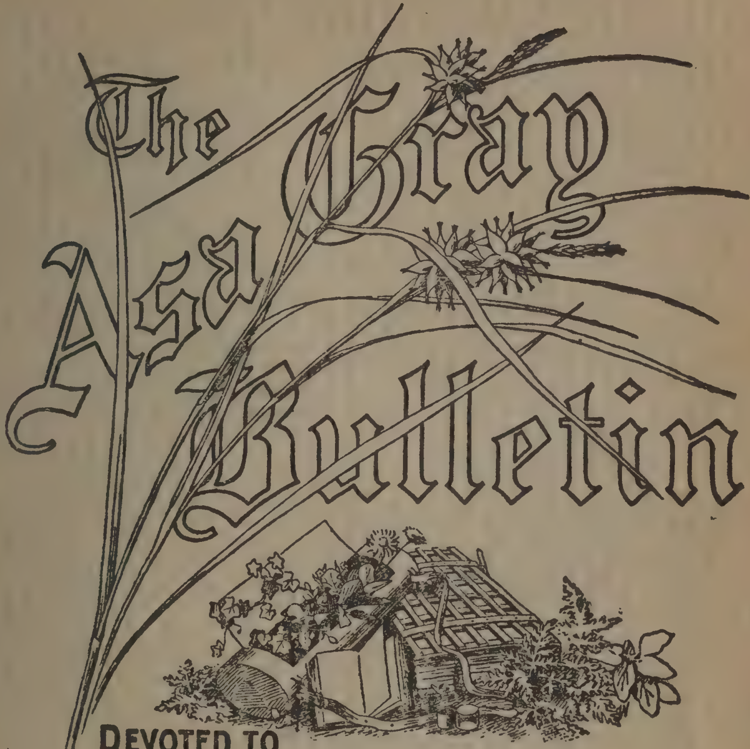

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NATURE STUDY, MANCHESTER, N. H.

THOMAS A. WILLIAMS.

Asa Gray Bulletin.

VOL. VIII. NO. 6. JANUARY, 1901. Whole No. 41.

Thomas A. Williams.

BY ALBERT F. WOODS.

Mr. Williams was born in Fremont County, Iowa, November 25, 1865. His parents belonged to that sturdy class of pioneers who carried civilization into the great desert and drove back the buffalo and the Indian. His father still lives, robust and active, a fine type of the men of those early days.

Thomas was the firstborn of a family of eight. Two brothers and a sister still live at Weeping Water, Nebr., where the family settled in 1867. This little town is built in one of the most picturesque spots in Nebraska. The bluffs on either side of the valley of a beautiful little stream are studded with great boulders overgrown with lichens and ferns and vigorous trees and vegetation of many kinds find a congenial soil both in the valley and on the hills. As a child, Mr. Williams loved to be out of doors, and early began to collect treasures from the rocks, the rivers, and the meadows. His parents did not send him to school until he was eight years old, but he had been going to school to "Nature, the dear old nurse," who teaches the children who love her better than we can do. He had learned to read at home and made rapid progress in the district school and afterward in the graded school. He could not give all of his time to study, however, or to roaming over the hills. There was much hard work to be done on the farm and he was always ready to do his share. The desire for greater knowledge grew within him, and at the age of eighteen he entered the University of Nebraska at Lincoln, as a preparatory student. After two years of successful work there his health broke down and he was urged to drop study for a time. He went back to the farm with great reluctance. Outdoor work for a summer greatly improved his health. He taught district school during the winter and then went back to the university.

Early in his university career he showed great love for and ability in the natural sciences, though he did not neglect the other studies which help to develop and train the mind. He had a special love for botany, and was familiarly known among the boys as "Cyclops," on account of the jeweler's lens, sticking out like a great eye, which he wore when examining lichens.

He was one of the seven who organized the Botanical Seminar of the University of Nebraska, which was probably the first botanical society of the kind in America. It was in these early college days that the writer's friendship with Mr. Williams began. We all loved him and admired his thorough, conscientious work and Christian spirit. After graduation, in 1889, he taught school for a year near Ashland, Nebr., then became principal of the Ashland high school. He was very successful as a teacher, but desired to devote himself more especially to botanical work.

After the first half year, at the Christmas holidays, he resigned from the Ashland school and went back to the University to finish his thesis for a Master's degree. The following February he was appointed assistant botanist in the Agricultural College of South Dakota. He was soon promoted to the head of the botanical department, and remained there as professor of botany for six years.

He spent the vacation of 1892-93 working with Dr. Trelease, in the Missouri Botanical Garden, at St. Louis, and the vacation of 1893-94 at Harvard University, working on the Tuckerman herbarium. The vacation of 1895-96 he spent in original research with Dr. Bessey at the University of Nebraska. This record shows how closely he applied himself to work. None of us doubt that he worked too hard. He was remarkably successful as a teacher and realized to an unusual degree the importance of training men for the practical work of life.

He was married in February, 1891, and had a particularly happy home life with his wife and child.

It was his very successful work in Dakota that led to his being called to the United States Department of Agriculture, in August, 1896. His work in the Department was marked by special energy and skill and he soon won the strong friendship and admiration of all who knew him.

In arranging the cooperative grass and forage plant investigations with the state experiment stations he showed remarkable power as an organizer, and did much to bring about a closer and more sympathetic relation betwen the Department and the stations. Besides his Department work, Mr. Williams had charge of the classes in botany at the Columbian University, and this took much of his time after office.

After the death of Mr. Hicks, in 1899, he became editor-in-chief of the Asa Gray Bulletin and bore much of the expense and labor of editing and publishing this valuable little journal. He continued his study of lichens through all, and became one of the foremost authorities on these plants. He was a member of numerous scientific societies and had a wide circle of friends and acquaintances who mourn his loss.

He loved to get out into the woods and fields for recreation and get close to the heart of nature. The beautiful words of Longfellow might have been written for him as well as for Agassiz:

> And Nature, the old nurse, took
>   The child upon her knee,
> Saying, "Here is a story-book
>   Thy Father has written for thee."
>
> "Come, wander with me," she said,
>   "Into regions yet untrod;
> And read what is still unread
>   In the manuscripts of God."

He was a follower of Jesus, the Christ, and as he is called to his new home we hear the echo of the Master's words: "Well done, good and faithful servant."

Mr. Williams was the author of many articles on botany and horticulture. Some of the more important ones are listed below:

DEPARTMENT OF AGRICULTURE, DIVISION OF AGROSTOLOGY.

Circular No. 4. The Renewing of Worn-Out Native Prairie Pastures.
Farmers' Bulletin No. 50. Sorghum as a Forage Crop.

Bulletin No. 6. Grasses and Forage Plants of the Dakotas.
Farmers' Bulletin No. 58. The Soy Bean as a Forage Crop.
Bulletin No. 12. Grasses and Forage Plants, and Forage Conditions of the Eastern Rocky Mountain Region.
Circular No. 10. Poa fendleriana and Its Allies.
Circular No. 12. Rape as a Forage Plant.
Farmers' Bulletin No. 101. The Millets.
Circular No. 17. Crimson Clover.
Circular No. 8 (Office of the Secretary). Cooperative Grass and Forage Plant Investigations with State Experiment Stations.

SOUTH DAKOTA EXPERIMENT STATION.

Bulletin No. 29. Fungi.
Bulletin No. 33. Some Plants Injurious to Stock.
Bulletin No. 35. Fungus Diseases and Insect Pests, joint author, L. C. Corbett.
Bulletin No. 43. Native Trees and Shrubs.
Bulletin No. 45. Forage Plants.
Bulletin No. 48. Potato Scab; Three Injurious Insects.

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Various published lists of collections determined, etc.

One who was very near to Mr. Williams wrote the following beautiful lines:

His days on earth are done—
His life is but begun.
His work is ended? No;
God would not have it so,
For he was crossed and tried,
Hampered and oft denied.
Yet honestly he wrought,
And faithfully he sought
The right. He fainted not,
Nor murmured that his lot
Held feebleness or pain.
To-day—we know his gain!

A larger work shall sure be given,
A broader field as seen from heaven
Than to our mortal sight appears,
And when our eyes are cleared of tears
A fruitful harvest field shall show
Where he has toiled that good might grow.

Resolutions Adopted by the Department of Agriculture.

It is with feelings of profound sorrow and regret that we, the employees of the Department of Agriculture, learn that death has removed from among us our beloved co-worker, Thomas A. Williams, a classmate and intimate associate of many of our number. His broad knowledge of scientific matters, his keen appreciation of nature, his kind and forbearing disposition has endeared him to all. He was known to his associates as an indefatigable worker.

Resolved, That in the death of Prof. Thomas A. Williams, science and agriculture have suffered a great loss, and we, his associates a dear friend, whose self-forgetfulness in his kindly consideration for the feelings of others, and uniform cheerfulness, often under conditions of severe physical suffering, revealed a lovable character of the highest Christian type.

The loss to the Division of Agrostology is irreparable. In the performance of his official duties he had proved himself an excellent executive and an organizer of unusual merit, and his relations with his associates in office were always such as to command the highest esteem and respect. He never shirked a duty, and however difficult the undertaking, the work performed by him was done most creditably. His loss will be felt most keenly by his associates in the Division, and his memory will remain with them as one whose exemplary life and steadfastness of purpose they should strive to emulate.

Resolved, further, That we tender to his bereaved family our heartfelt sympathy in their great loss, and invoke for them the blessing of the Heavenly Father, who alone can heal the broken heart and give lasting comfort.

Resolved, That copies of these resolutions be sent to the family of the deceased and to the various daily and scientific journals.

COMMITTEE ON RESOLUTIONS,
For the Department of Agriculture.

Resolutions Adopted by the Washington Botanical Club.

The members of the Botanical Club tender their heartfelt sympathy to the family of our late friend and fellow-member, Mr. T. A. Williams, in whose untimely death botanical science has suffered an irreparable loss.

We have each felt his death to be a personal loss. As a friend we found him steadfast, with a kindly indulgence to the faults of others, and a constant endeavorer to do the best he could under all circumstances.

His work as a botanist has been fruitful in results and promised to be still more so in the future. As a worker in Economic Agriculture in the Department he opened up new lines and laid a foundation upon which others will build.

As a club, we shall feel the loss of his suggestions and his criticisms always given in a kindly way and always helpful because of his broad knowledge of botany.

Mr. Williams was one of the charter members of the Botanical Club, and to his counsel the club owes much of its success.

Memorial of the Botanical Seminar of the University of Nebraska.

In the meeting of the Botanical Seminar, held January 10, 1901, the following memorial was read:

"In the death of Thomas A. Williams, Seminarius, 1886, the Botanical Seminar of the University of Nebraska mourns the loss of one of its most efficient and productive members, and the science of botany suffers an irreparable loss.

"We inscribe in our records our high appreciation of his worth as a man, his industry and ability as a botanist, and his loyalty and devotion as a member.

"His memory shall be treasured by his colleagues in the Seminar, and his nobleness of character shall be held as an example worthy of our imitation.

"It is decreed that for a decade an annual memorial to his life and works shall be read in open meeting of the Seminar."

List of Books for the Botanical Library of Secondary Schools.

DR. CHAS. E. BESSEY.

The following list is esentially that which will appear in the next edition of the "Nebraska High School Manual." This list may be easily adapted to use in my state by substituting for Gray's or Coulter's manual the manual covering the region:

Structural Botany:
- Arthur, Barnes and Coulter's Plant Dissection. ($1.25.)
- Bessey's Essentials of Botany. ($1.25.)
- Goebel's Outlines of the Classification of Plants. ($6.)
- Gray's Structural Botany. ($2.)
- Strasburger's Text-Book of Botany. ($2.50.)
- Vines' Text-Book of Botany. ($2.25.)

Physiological and Economic Botany:
- Goodale's Physiological Botany. ($2.)
- Arthur and MacDougal's Living Plants and Their Properties. ($1.25.)
- Kerner and Oliver's Natural History of Plants. ($15.)
- MacDougal's Nature and Work of Plants. (80c.)
- Coulter's Plant Relations. ($1.10.)
- MacDougal's Experimental Plant Physiology. ($1.)

Systematic Botany:
- Botanical Seminar; Flora of Nebraska. ($3.)
- Britton and Brown's Illustrated Flora of the Northern States and Canada ($9.)
- Coulter's Manual of the Botany of the Rocky Mountain Region. ($1.65.)
- Gray's Manual of Botany; sixth edition. ($1.65.)
- Underwood's Moulds, Mildews and Mushrooms. ($1.25.)

General Botany:
- Ganong's Teaching Botanist. ($1.10.)
- Bailey's Survival of the Unlike. ($2.)
- Campbell's Lectures on the Evolution of Plants. ($1.25.)

Sudden Appearance of Certain Plants on a Burned Wood Lot.

ALFRED W. HOSMER.

I found a rather interesting bit of country this last summer. A wood lot, about three acres or so, was cut off last winter, the first time for twenty-five years, and burned over in June. In the latter part of August it was covered with plants of *Corydalis* *glauca*, some 2 feet high, and more than that in diameter, with very brilliant flowers. I have traveled over this lot some five times or more a year for the past ten years, but never before was I able to find more than a dozen of these plants at the most, and those small, spindling ones, with pale flowers, most of them having but a single stalk. On this same lot, covering some 60 feet square, where there had been thick oak woods with never a sign of the plant, were mats of *Geranium carolinianum*. These were some 50 rods from the nearest place that I had ever found it, and there I had only seen the plants in 1892, '93, '95, '97, though I had hunted for them each year.

Among the Mycologists.

In the O. S. U. Naturalist for November, Dr. W. A. Kellerman describes a new smut found on the leaves of sorghum and sweet corn, under the name of *Ustilago* (*Cintractia*) *reiliana* f. *foliicola*. The fungus was grown in the greenhouse by artificial inoculation of the seed of the host plants.

T. A. W.

The meeting of the Pennsylvania Mycological Society on October 5, 1900, was full of interest. Many specimens, each showing two or more varieties of a family, were placed on the table for identification and study. Owing to the afternoon passing so rapidly we only had time to identify some forty varieties. Some of the remainder were eagerly carried home by enthusiastic members to be studied during the evening whilst the specimens were in favorable condition.

At each weekly meeting something new and of much interest has been brought in by those of our friends living many miles from our place of meeting. One member invited the society to her home, providing carriages to take us to the different woods in her neighborhood. A shower of rain obliged us to drive hastily home, where we had ample time to examine and study our specimens and to partake of a lunch provided by our kind hostess. We also brought home many specimens for our next meeting.

We had an exhibit of thirteen plates at the horticultural exhibition, November 13-17, showing many varieties of a family. The poisonous species of *Amanita* were represented by specimens. One plate had a curious dark brown specimen, resembling a carnation in form and another plate, *Geaster hygrometricus*. These came from Southern New Jersey, and were collected by Mrs. Starr. The other genera represented were *Pleurotus*, *Mycena*, *Hypholoma*, *Tricholoma*, *Flammula*, *Coprinus*, *Nancoria*, *Daedalia*, *Polyporus* and *Psalliota*.

HANNAH S. BLACKBURNE.

Editorial.

It is with deep regret that we announce to the readers of the Bulletin the death of its editor-in-chief, Prof. Thomas A. Williams, which occurred at his home at Takoma Park, D. C., December 23, 1900. Professor Williams had been at his work as usual the previous day, and though he had not been feeling particularly well for some time, neither he nor his family anticipated anything so serious. Heart disease was the cause of death. The copies of resolutions published elsewhere in the Bulletin show in what esteem he was held by his friends and co-workers, and how great a loss science and economic agriculture have suffered.

The publication of the Bulletin closes with this number. By an agreement between its stockholders and the publishers of The Plant World the journal passes into their possession. All unexpired subscriptions and advertising contracts will be filled by that journal. Back numbers of the Bulletin will be supplied by the Plant World, so long as they are available. The Plant World will be enlarged by four pages, which will be devoted to cryptogamic botany under the direction of the writer. In this way we hope still to keep in touch with the mycological clubs and various workers in cryptogamic botany and receive any articles or notes suitable for publication, as well as books or papers for review.

C. L. S.

Notes and News.

The Biological Club of the State University of Ohio has begun the publication of a journal under the title, "The O. S. U. Naturalist." John H. Shaffner is editor-in-chief, and he will be assisted by associate editors in the various departments of natural science. Professors Kellerman, Osborn and Bownocker are on the "advisory board."

T. A. W.

The first number of "The Gamophyllons, devoted to plant life in field, forest and garden," has just come to hand. It is published at Plainfield, N. J., by Harry A. Bird.

T. A. W.

Science, the weekly periodical edited by Professor J. McKeen Cattell, of Columbia University, and published by The Macmillan Company, has been adopted by that large and important body, the American Association for the Advancement of Science, for the publication of its official notices and proceedings, and will be sent to all members and fellows. This is a step which will be welcomed by the great body of workers in the many branches of science, as it brings the journal and the Association into line for the best interests of research and the diffusion of scientific knowledge.

Recent Literature.

The demand for information relative to the fleshy fungi may well be judged from the numerous publications on the subject that have appeared during the past year or two. One of the latest books dealing with these plants is by Dr. Atkinson, of Cornell University,* and contains nearly 300 pages, with over 200 figures, and 76 full-page plates, many of which are colored. In all, some 200 species are described, selections being made of "those species representing the more important genera * * * illustrating, as far as possible, all the genera of agarics found in the United States," and also "illustrative genera and species of all the other orders of the higher fungi, in which are included many of the edible forms." The various species are described at some length, and much valuable information is given regarding habit of growth, uses and injurious character of the different sorts. New species are described in several genera, notably *Hypholoma*, *Amanita*, *Lepiota*, *Mycena*, *Bolbitius*, *Paxillus* and *Hydnum*. The work is most profusely illustrated from photographs, drawings and paintings. The photographic illustrations are in the main excellent; if anything, better than the color reproductions. In addition to keys and descriptive matter the book contains chapters on "Collection and Preservation of the Fleshy Fungi," "Selection and Preparation of Mushrooms for the Table," and also one on "Recipes for Cooking Mushrooms," contributed by Mrs. S. T. Rorer; one on "Chemistry and Toxicology of Mushrooms," by J. F. Clark, and one on "Description of terms applied to certain structural characters of mushrooms," by H. Hasselbring. The binding and typography are excellent and the book will prove a most useful one to students of the higher fungi.

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*Mushrooms; Edible, Poisonous, Etc. By George Francis Atkinson, Professor of Botany in Cornell University. Andrus & Church, Pubs., Ithaca, N. Y. Price, $3.

T. A. W.

"Among the Mushrooms"* is the title of a small volume recently received. The authors state in the introduction that the "book is intended for those who, though ignorant on the subject, desire to know something about mushrooms." A desire to know something about mushrooms is commendable and should be encouraged, but we think that this *something* should be of a definite and exact nature, especially if it is to be used as a basis for selecting edible species or as a foundation for further study. The old adage that "A little knowledge is a dangerous thing," is particularly applicable in the case of mushrooms.

Following the introduction of twenty-one pages are some general remarks on the morphology of mushrooms. Then, under the heading, "Classification of Fungi," three classes are given: I. Gasteromycestes, II. Ascomycetes, III. Hymenomycetes. These three classes are then taken up in the following order: III, I, II, and some general characteristics given of some of the orders and genera. The genera of Agarics are here arranged according to the spore colors. At the end of the chapter on classification are several pages under the heading, "General Helps to the Memory." Here the genera of Agarics are arranged in groups depending upon various gill and stem characters, and also a repetition in columnar form of the spore-color classification. The next chapter consists of "Descriptions of Fungi Arranged According to Color of Cap Only." Here descriptions of miscellaneous species are given. These descriptions are fairly accurate. The next heading is "Descriptions of Some Familiar Mushrooms Without Regard to Color." Under this is included fungi "which can not be classified by the color of the cap." The first species described is *Fistulina hepatica*. We are at a loss to know why this should be excluded from a color classification. Finally, there are two other keys, the first covering all the forms treated of the three classes, the second as an appendix giving another spore-color key of the agarics. We regret to say that the general impression left after a careful perusal of the book is that of an attempt at the possible permutations in the arrangement of the genera and species treated. This is evidently the result, however, of the authors' sincere attempt to make easy the path of the novice. We have serious doubts of the success of this attempt. The book contains two color plates and nine half-tones. As usual, the half-tones are much more satisfactory than the color plates. A commendable feature of the book is the glossary at the end.

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*Among the Mushrooms. A manual for beginners, by E. M. Dallas and C. A. Burgin. Drexel Biddle, Pub., Philadelphia, Pa. Price, $2.

C. L. S.

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Fig. 6. Noonday position of the leaves of the sensitive plant.

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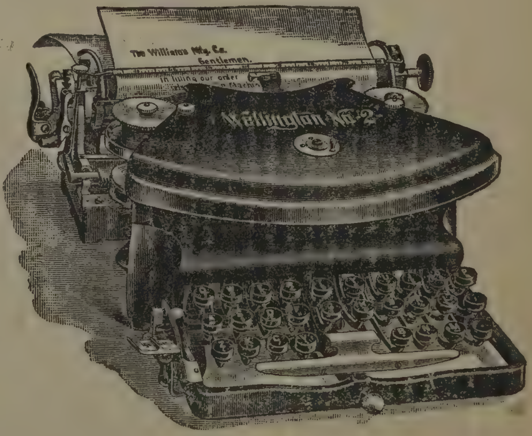

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